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Bristol-Myers Squibb Manufacturing Company

Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

July 2015

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1.0 Introduction

Bristol-Myers Squibb Manufacturing Company (BMSMC) - Humacao Operations, has been implementing a RCRA Corrective Action Program in accordance with the provisions of Module III of its Final RCRA Hazardous Waste Management Permit No. PRD090021056 (RCRA permit). A site location map for the BMSMC facility in Humacao is provided in **Figure 1**. In July 2011, BMS Humacao submitted a revised Corrective Measures Study (CMS) Report to the United States Environmental Protection Agency (USEPA). The CMS Report identified soil and groundwater impacts within close proximity to Building 5 located in the Building 5 Area (SWMU No. 20).

The USEPA provided comments on the 2011 CMS Report in February 2012, indicating the need for BMSMC to complete a comprehensive vapor intrusion investigation to evaluate potential health risks associated with vapor intrusion into occupied or potentially occupied buildings. Indoor air samples were collected in Building 5 as part of the vapor intrusion investigation completed by BMSMC in 2012. This investigation was completed in accordance with the USEPA-approved *Soil Vapor Investigation Work Plan* (AMAI, 2012b). Results of the Building 5 indoor air sampling were submitted to the USEPA in the *Vapor Intrusion Investigation Report* (AMAI, 2012c). Results indicated that each of the Building 5 Area contaminants of concern (COCs) was detected in one or more indoor air samples. The concentration of two Building 5 Area COCs (ethylbenzene and xylene) exceeded their May 2012 USEPA industrial indoor air regional screening level. Building 5 Area COCs are listed below.

- Acetone
- Benzene
- Ethylbenzene
- Methyl Isobutyl Ketone (MIBK)
- Toluene
- Xylenes
- Isopropyl Alcohol (IPA)
- Methanol
- Methane[1]

The USEPA updated the vapor intrusion RSLs in June 2015. **Table 1** provides the soil gas, indoor air, and target groundwater concentration RSL for each Building 5 COC. The RSLs

[1] Methane is not a Building 5 COC, however methane is included in the vapor intrusion evaluation due to explosivity considerations.

provided in **Table 1** are based on an industrial exposure scenario, a target risk of 10^{-6} for carcinogenic compounds, and a hazard quotient of 1 for non-carcinogenic compounds. For explosion hazards, such as methane, the USEPA recommends using 10 percent of the lower explosive limit (LEL) to identify potential explosion hazards (USEPA, 2015a). Therefore, the screening level for methane has been set equal to 3,280,000 $\mu g/m^3$ which is equal to 10 percent of the LEL for methane of 32,800,000 $\mu g/m^3$ (50,000,000 ppb).

Building 5 has remained an unoccupied space since 2006 and Building 5 has been used primarily for the storage of office and pharmaceutical manufacturing equipment since 2012. BMSMC is currently re-evaluating the future use of Building 5, although its specific future use and future configuration is unknown at this time.

In 2013, approximately 1,800 cubic yards of impacted soil was excavated from an area adjacent to and north of Building 5. A detailed discussion of the 2013 soil removal is presented in the *Building 5 Area Source Removal Phase 5 Implementation Report*, submitted to the USEPA in April 2015 (AMAI, 2015). Prior to the implementation of soil excavation activities, a methane soil venting program was initiated to mitigate any potential safety issues that could occur from the release of methane during the soil excavation activities. The soil removal was completed as part of a USEPA-approved Temporary Unit that included ex-situ biological treatment of impacted soil followed by off-site disposal.

BMSMC believes the removal of impacted soil and the venting of methane likely resulted in a substantial reduction of the source of vapor intrusion into Building 5. Therefore, in order to evaluate current and potential indoor air concerns within Building 5, BMSMC submitted a *Building 5 Vapor Intrusion Work Plan* to the USEPA in August 2014. The final *Building 5 Vapor Intrusion Work Plan* (Work Plan) was approved by the USEPA in December 2014 (AMAI, 2014). As noted in the Work Plan, the objective of the vapor intrusion investigation was to determine if the vapor intrusion pathway poses an unacceptable risk to potential receptors (i.e., complete exposure pathway). According to the USEPA (USEPA, 2015a), a vapor intrusion pathway is considered complete when the following five conditions are met under current conditions:

1) A subsurface source of vapor-forming chemicals is present (e.g., in the soil or in groundwater) underneath or near the building;

2) Vapors form and have a route along which to migrate (be transported) toward the building;

3) The building is susceptible to soil gas entry, which means openings exist for the vapors to enter the building and driving 'forces' (e.g., air pressure differences between the building and the subsurface environment) exist to draw the vapors from the subsurface through the openings into the building;

4) One or more vapor-forming chemicals comprising the subsurface vapor source is present in the indoor environment; and

5) The building is occupied by one or more individuals when the vapor-forming chemical is present indoors.

The USEPA also notes that if one (or more) of the five conditions listed above is currently absent and is reasonably expected to be absent in the future, then the vapor intrusion pathway is considered to be incomplete (USEPA, 2015a).

BMSMC implemented the *Building 5 Vapor Intrusion Work Plan* in December 2014. Based on the results of the sub-slab soil gas samples collected in Building 5, BMSMC decided to evaluate the potential for vapor intrusion in a portion of Building 6 that is located directly adjacent Building 5. This portion of Building 6 is currently used for warehouse space, a Water Purification area, a shipping area, and a shipping office. Therefore, sub-slab soil gas and indoor air samples were collected in Building 6 according to the protocols in the Work Plan.

This report presents the results of the vapor intrusion sampling conducted in Building 5 in December 2014 and in Building 6 in February-March and June 2015.

Section 2 provides a summary of the Building 5 Area hydrogeology, a summary of previous vapor intrusion investigations, a description of each building evaluated in the vapor intrusion study, including building characteristics, and current and proposed building use. Section 3 discusses the sampling and analysis activities completed during the vapor intrusion investigation and the results of the indoor air building surveys. Results of the vapor intrusion investigation are discussed in Section 4. Summary conclusions and recommendations are presented in Section 5. References are included in Section 6.

2.0 Building 5 Area Site Descriptions

A detailed description of the Building 5 Area including site history, hydrogeological setting, and soil and groundwater impacts are provided in the 2011 CMS Report (AMAI, 2011). The location of Building 5 and Building 6 within the BMSMC facility is provided in **Figure 2**. Building 5 and Building 6 are the only buildings within the Building 5 Area that are either currently occupied or may be occupied in the future. Specific site characteristics important to the evaluation of the vapor intrusion pathway within the Building 5 Area are summarized below.

2.1. Hydrogeological Setting

Soil borings completed in the Building 5 Area indicate the area is underlain by two to six feet of fill material consisting of a variable mixture of gravel, sand, and clay. Moisture conditions within the fill material were generally dry to moist. Fine-grained material consisting of silt, clay and interbedded coarse-grained sand lenses is present below the fill. The fine-grained material is typically dry to moist and four to five feet thick. Coarse-grained sand is present below the fine-grained silt and clay. The top of the coarse-grained sand is typically between eight to 10 feet below surface (bgs). Groundwater in the Building 5 Area appears to be under semi-confined conditions and is typically encountered within the coarse-grained sand.

2.2. Previous Vapor Intrusion Investigations and Groundwater Impacts

Results of the Soil Vapor Investigation completed in the Building 5 Area in 2012 were presented and discussed in the 2012 *Vapor Intrusion Investigation Report* (AMAI, 2012c). Findings of the *Vapor Intrusion Investigation Report* are summarized below.

- Building 5
    - Two rounds of indoor and ambient air samples were collected in Building 5.
    - Each Building 5 COC was detected in each indoor air sample.
    - The concentration of ethylbenzene and xylene exceeded the USEPA industrial indoor air RSL in every sample.
    - Low levels of each COC were detected in each ambient air sample.
    - Methane was detected in every indoor air sample.
    - Methane was not detected in any of the ambient air samples.

- Building 6
    - Near-slab soil gas samples were collected along the western and eastern sides of Building 6.
    - Each Building 5 COC was detected in each near-slab soil gas sample.
    - The concentration of benzene in one near-slab soil gas sample exceeded the USEPA industrial soil gas screening level for benzene.
    - The concentrations of all other Building 5 Area COCs in near-slab soil gas samples were less than their USEPA industrial soil gas screening level.

The current extent of impacted groundwater in the Building 5 Area is shown on **Figure 3**. **Figure 3** was generated using xylene concentration data in groundwater samples collected in March 2015. Xylene groundwater concentration data was used to represent the groundwater plume since xylene is the most pervasive COC detected in groundwater in the Building 5 Area.

2.3. Building 5 Characteristics and Uses

Building 5 is an approximately 18,000 square foot two-story building, constructed in 1974 and was initially used as a bulk chemical manufacturing facility that produced intermediate and final bulk pharmaceuticals. Former operations included chemical synthesis extraction, filtration, crystallization, pH adjustment, concentration, and drying, among others. The building contained process vessels, virgin material tanks, product storage tanks, and waste tanks. The concrete floors had drains that lead to the biological waste treatment plant. Building 5 ceased manufacturing operations in 2006 and was decommissioned. The building has not been occupied since 2006 and all former equipment, including heating, ventilation, and air conditioning (HVAC) equipment, has been removed. Since 2012, the first floor of Building 5 has been used for the storage of pharmaceutical manufacturing and office equipment. The second floor of Building 5 is currently unused, unoccupied, and vacant.

A review of Building 5 construction plans indicates that the Building 5 foundation consists of a slab on grade and an eight-inch reinforced concrete floor slab separated by approximately four feet of compacted fill material. A review of the Building 5 *Plumbing, Process Drain, and Utility Piping, Underground Plan* (Drawing No. 8-3300, 1974) indicates the presence of underground piping throughout most of the building with most of the former solvent waste piping concentrated in the northeast quadrant of Building 5. The underground pipes were laid in trenches below the floor. Details of the trench design and bedding material are unknown.

2.4. Building 6 Characteristics and Uses

Building 6 is a 49,533 square foot two-story building located immediately to the south of Building 5 and farther away from the area of impact (see **Figure 3**). Building 6 was originally constructed in 1974 as an approximately 33,000 square foot formulating and processing building. Building 6 is currently an active pharmaceutical manufacturing facility that is in use and occupied 24 hours per day and seven days a week. The first floor of Building 6 consists of numerous pharmaceutical manufacturing and packaging clean rooms, product storage, offices, locker rooms, utility areas, shipping and receiving rooms, and three elevators. Additional production facilities, offices, and mechanical equipment are located on the second floor. HVAC equipment is also located on the second floor and on the roof. The ground floor of Building 6 consists generally seven inches of reinforced concrete supported by piling foundations and concrete footings.

This portion of Building 6 included in the Building 5 Area vapor intrusion investigation is currently used for warehouse space (Room 127), a Water Purification Area (Room 129), and a shipping office (Room 188A). The characteristics and usage for each of these areas is described below. The location of each of these areas is shown on **Figure 4**.

2.4.1. Warehouse Area (Room 127)

The warehouse area (Room 127) is approximately 3,900 square feet and was formerly used as warehouse space for maintenance and utility items storage. BMSMC is in the process of reconfiguring Room 127 from warehouse space to pharmaceutical production space. Room 127 is constructed with concrete and drywall walls and concrete floors coated with a vapor intrusion sealant (Retro-Coat™). Construction activities completed prior to sampling in March 2015 included the partial demolition of concrete flooring for installation of new floor drains and underground piping and the restoration of the concrete flooring removed with new concrete. Other construction activities completed prior to the February-March 2015 sampling included partial concrete wall removals, and construction of new aluminum stud framing and drywall.

BMSMC anticipates Room 127 will be occupied from four to 12 hours per day after it is converted to pharmaceutical production space.

2.4.2. Water Purification Area (Room 129)

The Water Purification Area (WPA) (Room 129) consists of two areas separated by a common wall. The north area (Purified Water Area Tank Room) contains two water storage tanks used to store purified water. The Purified Water Area Tank Room is not normally occupied. This area

is approximately 630 square feet and is constructed with concrete walls and concrete floors coated with epoxy paint. The area is accessible from the outside on the north side and from the adjacent WPA south area on the south side. The Purified Water Area Tank Room contains floor drains and underground pipe penetrations in the floor. The area is ventilated by natural air circulation from louvers located on the north exterior wall. The area is only visited for periodically scheduled inspections or maintenance.

The south Area (Purified Water Area Equipment Room) contains water purification equipment including a water distillation and reverse osmosis water purification skid, water tanks, water pumps, and electrical panels. The area is approximately 1,700 square feet and is constructed with concrete walls and concrete floors coated with epoxy paint. The area is only visited for periodically scheduled inspections or maintenance. The area is accessible from an exterior corridor on the east side and from the adjacent room (Purified Water Area Tank Room) on the north side. The area contains floor drains and underground pipe penetrations in the floor. The Purified Water Area Equipment Room is ventilated by natural air circulation from louvers located on the east exterior wall and large industrial fans.

2.4.3. Shipping Office (Room 188A)

Room 188A is used by the material handling supervisor for clerical purposes. The room is approximately 80 square feet and is constructed with concrete walls, and a concrete floor with vinyl tiles. Room 188A is occupied approximately 70 percent of the time during normal daytime working hours. Room 188A is only accessible from the shipping dock room (Room 188). No floor drains are present in room. Room 188A is ventilated with re-circulated air at a rate of approximately 15 air changes per hour.

3.0 Vapor Intrusion Sampling and Analysis

A vapor intrusion investigation was conducted at Building 5 and Building 6 to assess the vapor intrusion pathway and to evaluate the potential health risk associated with the inhalation of indoor air at the two buildings. All sampling and analysis activities were completed in accordance with the USEPA approved Work Plan.

In accordance with the Work Plan, co-located sub-slab soil gas and 24-hour indoor air samples were collected on the first floor of Building 5 and 24-hour indoor air samples were collected on the second floor of Building 5. Based on the results of the Building 5 vapor intrusion sampling, co-located sub-slab soil gas and 24-hour indoor air samples were also collected in Building 6. Samples collected in Building 6 were collected and analyzed according to the protocols described in the Work Plan.

In advance of sampling, indoor building surveys were also completed for Building 5 and Building 6. The sampling and analytical activities conducted during Building 5 Area vapor intrusion investigation as well as any deviations from the Work Plan are discussed below.

3.1. Building 5 Area

3.1.1. Building 5

An indoor building survey was conducted in Building 5 on December 8, 2014 to verify building construction characteristics, to identify potential vapor intrusion pathways, to identify potential indoor sources of volatile organic compounds (VOCs), and to select final indoor air sample locations. A completed Building 5 Indoor Air Building Survey Form is provided in **Appendix A**. Results of the indoor building survey identified the following building conditions:

- The ventilation fan was operational up until 24-hours before the sampling was performed. The ventilation fan was not operated 24-hours prior to or during the sampling.
- Total VOC concentrations in the breathing zone as measured using a photoionization detector (PID) ranged from 0.6 ppm to 3.5 ppm on the first floor.
- The methane concentration in the breathing zone as measured using a hand-held monitor was non-detectable.

The Building 5 indoor air sampling was initiated on December 8, 2014 and completed on December 9, 2014. Sub-slab samples were collected on December 10 and December 11, 2014. The first and second floors of Building 5 were subdivided into four quadrants as shown on

Figure 5. In accordance with the Work Plan, seven indoor air (B5IA-1 through B5IA-7) and seven co-located sub-slab soil gas samples (B5SS-1 through B5SS-7) were collected within the first floor of Building 5. One indoor air/sub-slab soil gas sample was collected at the approximate center of each quadrant, two indoor air/sub-slab soil gas samples were collected along the common wall between Building 5 and Building 6, and one indoor air/sub-slab soil gas was collected at the location where the highest PID reading was noted during the indoor air building survey (this indoor air sample was collected close to the floor; not at normal breathing elevation). Four indoor air samples (B5IA-8 through B5IA-11) were collected on the second floor of Building 5. Samples were located at the approximate center of each quadrant. One duplicate indoor air sample (B5IA-3D) and one duplicate sub-slab soil gas sample (B5SS-1D) was collected as part of the Building 5 vapor intrusion investigation. Approximate sample locations are shown on **Figure 5**.

Indoor air samples were collected using a 6-liter passivated canister equipped with a 24-hour flow controller and particulate filter. Canisters were positioned such that the sample inlet was approximately four feet above the ground floor. One ambient air sample (B5IA-AA) was collected concurrently with the indoor air samples to establish outside background air quality conditions. Sample B5IA-AA was located approximately 100 feet upwind (east) of Building 5 (see **Figure 5**).

Initial and final canister pressures, inside and outside initial and final temperatures, initial and final barometric pressures, and other pertinent observations were recorded on the TO-15 Indoor/Ambient Air Sampling Form. Completed sampling forms are provided in **Appendix B**.

Sub-slab soil gas samples were collected using a 1-liter passivated canister equipped with a five-minute flow controller and particulate filter. Prior to sampling, a 3/8-inch hole was drilled through the floor slab to approximately three inches below the floor slab. Teflon™-lined tubing was then inserted into the drill hole below the base of the floor slab. The annular space around the tubing was sealed using modeling clay and a helium leak check was completed to verify that the sub-slab sample point was properly sealed from indoor air. Once the sample point was properly sealed and verified with a successful leak check, the sub-slab sample was collected in the 1-liter canister. Sub-slab soil gas locations were sealed with cement after the samples were collected.

Indoor air, ambient air, and sub-slab soil gas samples were submitted to Eurofins Air Toxics, Inc. (Eurofins) of Folsom, CA for analysis of VOCs according to USEPA Method TO-15 and methane according to ASTM D-1946. The Work Plan indicated that samples would be analyzed only for the Building 5 Area COCs. However, a review of the raw VOC data for the 2012 Building 5 indoor air analytical results presented in the 2012 Vapor Investigation Report

indicated additional VOCs were present in Building 5 indoor air (AMAI, 2012c). Therefore, in order to complete a comprehensive evaluation of the vapor intrusion pathway, BMSMC decided to have the analytical laboratory report the full TO-15 compound list rather than a short list consisting only of the Building 5 Area COCs.

All Building 5 analytical results were validated according to USEPA guidelines identified in the Work Plan and project-specific Quality Assurance Project Plan (QAPP) (AMAI, 2012a).

3.1.2. Building 6

The Building 6 vapor intrusion investigation included the collection of indoor air and sub-slab soil gas samples in a shipping office (Room 188A), Water Purification Area (Room 129), and a warehouse area (Room 127). Indoor building surveys for the Water Purification Area and shipping office were conducted on February 2, 2015. Due to construction activities (described below), the indoor building survey for the warehouse area (Room 127) was completed later (on March 1, 2015). The warehouse area was resampled in June 2015. Completed Indoor Air Building Survey Forms are provided in **Appendix A** and results for each room are summarized below.

- Shipping Office (Room 188A)
    - Used as an administrative office.
    - Hand sanitizer present in office prior to sampling and IPA drum found in adjacent room (Room 188). Both were removed at least 24 hours prior to sampling.
    - Room is ventilated with re-circulated air at a rate of approximately 15 air changes per hour.
- Water Purification Area (Room 129)
    - The area contains two water storage tanks and water purification equipment including a water distillation and reverse osmosis water purification skid, water tanks, water pumps, and electrical panels.
    - The area contains floor drains and underground pipe penetrations in the floor.
    - Room is ventilated by natural air circulation from louvers located on the east exterior wall and large industrial fans.
    - No chemicals were present in the room before or during the sampling.
- Warehouse Area (Room 127)
    - Currently under construction.

- In January, February, and March 2015, Room 127 was empty and unoccupied except for construction workers.
- Openings through the common wall between Building 5 and Building 6 were sealed with cardboard and tape 24 hours prior to the collection of indoor air samples.
- Room 127 contains floor drains and underground pipe penetrations in the floor.
- HVAC in Room 127 was currently not operable during the sampling event.
- 24-hours prior to the sampling, Room 127 was ventilated by a portable air fan that drew air into the space from the adjacent Loading Dock Air Lock Room.
- Room was not ventilated during the 24-hour period prior to the sampling, or during the sampling.

Shipping Office (Room 188A) and Water Purification Area Sampling (Room 129)

Two 24-hour indoor air samples were collected in the shipping office (B6-3IA and B6-3IAD) and two 24-hour indoor air samples (B6-4IA and B6-5IA) were collected in the Water Purification Area from February 2 to February 3, 2015. Sample B6-3IAD was a duplicate of sample B6-3IA. A 24-hour ambient air sample (B6-AA-1) was also collected from February 2 through February 3, 2015. On February 4, 2015, two sub-slab soil gas samples (B6-3SS and B6-3SSD), co-located with indoor air sample B6-3IA, were collected in the shipping office and one sub-slab soil gas sample (B6-5SS), co-located with indoor air sample B6-5IA was collected in the Water Purification Area. Sample B6-3SSD was a duplicate of sample B6-3SS. A second sub-slab soil gas sample (B6-4SS), co-located with indoor air sample B6-4IA, was collected in the Water Purification Area on February 6, 2015. The approximate location of the indoor air and sub-slab soil gas samples collected in the shipping office and Water Purification Area, as well as the ambient air sample locations, is shown on **Figure 6**.

Warehouse Area (Room 127)

As noted above, BMSMC is in the process of converting the warehouse area (Room 127) in Building 6 into a multi-room manufacturing space. As part of the conversion process, BMSMC installed floor drains within Room 127 which required the removal of portions of the floor and trenching to a depth of approximately four feet below the finished floor elevation. During construction activities, BMSMC screened the soil in the trenches and ambient air for total VOCs with a field calibrated organic vapor meter (OVM) equipped with a PID to determine if impacted soil was present beneath this area of Building 6 and to determine any potential health risks to construction workers if impacted soil was identified. PID readings within the trenches ranged from 0 ppm to 3.2 ppm and PID reading within the breathing zone ranged from 0 ppm to 0.9

ppm. After the installation of the drains, the floor of Room 127 was sealed with a vapor intrusion sealant (Retro-Coat™).

Indoor air and sub-slab soil gas samples were collected in Room 127 approximately 30 days after the Retro-Coat™ sealant was installed to allow the sealant to cure properly. Three 24-hour indoor air samples (B6-1IA, B6-2IA, and B6-2IAD) were collected in the warehouse area from March 1 to March 2, 2015. Sample B6-2IAD was a duplicate of sample B6-2IA. One 24-hour ambient air sample (B6-AA-2) was also collected during the indoor air sampling. Ambient air sample B6-AA-2 was collected at the same location as ambient air sample B6-AA-1. On March 2, 2015, sub-slab soil gas sample B6-1SS, co-located with indoor air sample B6-1IA, and sub-slab soil gas sample B6-2SS and duplicate sub-slab soil gas sample B6-2SSD, co-located with indoor air sample B6-2IA, were collected within the warehouse area. The approximate location of the indoor air and sub-slab soil gas samples collected in the warehouse area, as well as the ambient air sample location are shown on **Figure 6**.

As discussed subsequently in Section 4, results of the March 2015 indoor air sampling in the warehouse area indicated elevated levels of isopropyl alcohol (IPA). An IPA-like odor and elevated PID readings were noted in the southeast corner of the warehouse area during the March 2015 indoor air sampling. BMSMC has documented that IPA is routinely used in Building 6 to clean pharmaceutical manufacturing equipment located within Building 6. BMSMC has also documented that cleaning with IPA had occurred in Building 6 near the warehouse area during the March 2015 sampling. As a result, a second round of 24-hour indoor air samples were collected in the warehouse area of Building 6 during a time when cleaning with IPA was not scheduled to occur during the 24-hour sampling period.

A second Building 6 indoor building survey was conducted on June 6, 2015 prior to the collection of the second round of indoor air samples. A completed June 2015 Building 6 Indoor Air Building Survey Form is provided in **Appendix A**. Results of the indoor air building survey identified the following building conditions:

- A ventilation system was operational for the space up until 24-hours before the sampling was performed. The ventilation system was not operated 24-hours prior to or during the sampling.
- The space was cleared of all construction equipment and materials prior to and during the sampling.

- Wall openings between Building 5 and the Warehouse Room were sealed prior to, and during the sampling with polyvinyl chloride (PVC) coated cardboard and duct tape.
- TVOC concentrations in the breathing zone ranged from 0.003 ppm to 0.007 ppm, compared to 0.850 ppm to 1.216 during the first survey of the area in March 2015.

Three 24-hour indoor air samples (B6-1IA-2, B6-2IA-2, and B6-2IA2D) and one ambient air sample (B6-AA-3) were collected from June 6 to June 7, 2015. Ambient air sample B6-AA-3 was collected at the same location as ambient air samples B6-AA-1 and B6-AA-2. Each sample was collected at the same location as the March 2015 indoor air sampling (see **Figure 6**).

Indoor air, ambient air, and sub-slab soil gas samples obtained in Building 6 were collected using the same methods described above for the Water Purification Area. All samples were submitted to Eurofins for analysis of the Building 5 Area COCs according to USEPA Method TO-15 and methane according to ASTM D-1946. All Building 6 analytical results were validated according to USEPA guidelines identified in the Work Plan and project-specific Quality Assurance Project Plan (QAPP) (AMAI, 2012a).

4.0 Vapor Intrusion Sampling Results

As part of the Building 5 Area vapor intrusion evaluation activities, indoor air, sub-slab soil gas, and ambient air samples were collected in and near Building 5 and Building 6. All analytical results are considered valid and usable to evaluate the vapor intrusion pathway in the Building 5 Area. Analytical results were compared to the media-specific June 2015 USEPA industrial RSLs provided in **Table 1** to evaluate potential health risks to site workers. For all results, compounds that were not detected are presented as less than the reporting limit. The method detection limit is also provided for non-detect results when the reporting limit was greater than the screening level. Results for samples collected in Building 5 and Building 6 are presented and discussed below.

For the vapor intrusion pathway, the source and mechanism of release has been identified as the Building 5 Area COCs present in soil and groundwater. The transport medium for the vapor intrusion pathway includes soil gas and indoor air. The point of potential human contact includes current and future site workers. The exposure route for the vapor intrusion pathway is inhalation of indoor air.

4.1. Building 5 Indoor Air/Sub-Slab Soil Gas Sampling Results

One round of indoor air and sub-slab soil gas sampling was completed in Building 5 in December 2014[2]. The results of this sampling round are discussed below.

4.1.1. Sub-Slab Soil Gas Sampling Results

Validated analytical results for the December 2014 Building 5 sub-slab soil gas samples are provided in **Table 2**. Analytical results are provided for the Building 5 Area COCs as well as other detected TO-15 compounds. The USEPA target industrial soil gas screening levels for the Building 5 Area COCs and other detected TO-15 compounds, derived from the USEPA VISL Calculator (USEPA, 2015b), are also shown on **Table 2**. Concentrations that exceed the USEPA industrial soil gas screening level are shaded. The distribution of TO-15 compounds detected in sub-slab soil gas samples is illustrated in **Figure 7**. Laboratory analytical reports and validation reports are provided on compact disc (CD) in **Appendix C** and **Appendix D**, respectively.

[2] Two rounds of indoor air sampling were completed in Building 5 in 2012. Results of the 2012 sampling indicated elevated levels of Building 5 Area COCs were present above their respective industrial air RSLs. Results of the 2012 indoor air sampling in Building 5 are presented and discussed in the *Vapor Intrusion Investigation Report* that was submitted to the USEPA in 2012.

Building 5 Area COCs

Sampling results indicate the following Building 5 Area COCs were detected in each sub-slab soil gas sample: toluene, ethylbenzene, xylenes, acetone, isopropyl alcohol, and MIBK. Methanol was detected in one sub-slab soil gas sample. Benzene was not detected in any sub-slab soil gas sample.

A comparison of the USEPA industrial soil gas screening levels to the sub-slab soil gas sampling results indicates that the concentration of ethylbenzene, toluene, xylene, acetone, IPA, and MIBK exceeded their USEPA screening levels of 164 $\mu g/m^3$, 730,000 $\mu g/m^3$, 15,000 $\mu g/m^3$, 4,500,000 $\mu g/m^3$, 29,000 $\mu g/m^3$, and 440,000 $\mu g/m^3$, respectively. The distribution and relative concentrations of the Building 5 Area COCs detected in the sub-slab soil gas samples were similar. The highest concentration of each of the Building 5 Area COCs was detected in the northeast quadrant (in sample B5SS-1 or B5SS-5) and the concentration of each of these compounds decreased by several orders of magnitude in samples collected in the southern half of Building 5. For example, ethylbenzene concentrations exceeded the screening level in three samples (B5SS-1[3], B5SS-3, and B5SS-5). Each of these samples was located in the northern half of Building 5 (see **Figure 7**). The highest ethylbenzene concentration (1,700,000 $\mu g/m^3$) was detected in B5SS-5 which was located in the northwest corner of the northeast quadrant. Other samples in which the ethylbenzene concentration exceeded its screening level included B5SS-1 (130,000 $\mu g/m^3$), located in the center of the northeast quadrant, and B5SS-3 (2,000 $\mu g/m^3$), located in the center of the northwest quadrant. Ethylbenzene concentrations in samples collected in the southern half of Building 5 (B5SS-2, B5SS-4, B5SS-6, and B5SS-7) were each less than the industrial soil gas screening level and two to five orders of magnitude less than the ethylbenzene concentrations detected in the northern half of Building 5. The significant decrease in ethylbenzene concentrations in sub-slab soil away from the northeast quadrant indicates a localized source of impacted sub-slab soil gas below the northeast quadrant of Building 5 and rapid attenuation of ethylbenzene beyond the source of impacts.

As part of the ongoing Corrective Measures Study, BMSMC is planning to complete several soil borings in the northeast quadrant of Building 5 to evaluate the subsurface soil conditions beneath Building 5. Details of the proposed borings are provided in the BMSMC *Response to Comments: Corrective Measures Study Report* document that was submitted to the USEPA in July 2015.

[3] The concentration of ethylbenzene, xylene, IPA, and MIBK in duplicate sample B5SS-1D also exceeded their respective industrial soil gas screening levels.

Other TO-15 Compounds

The validated analytical results for other TO-15 compounds detected in sub-slab soil gas samples collected beneath Building 5 are provided in **Table 2**. The distribution of other TO-15 compounds detected in sub-slab soil gas samples collected beneath Building 5 is provided in **Figure 7**. A number of other TO-15 compounds were detected in sub-slab soil gas samples collected beneath Building 5. A comparison of the USEPA industrial soil gas screening levels to the sub-slab soil gas analytical results indicates the following VOCs were detected above their sub-slab soil gas screening level:

- Chlorobenzene
- Chloroform
- Methy Tert-Butyl Ether (MTBE)
- Methylene Chloride
- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- 1,2,4-Trimethylbenzene

Similar to the Building 5 Area COCs, the highest concentrations of other TO-15 compounds were detected in the sub-slab soil gas samples collected in the northeast quadrant of Building 5 (see **Figure 7**). MTBE, TCE, and 1,2,4-trimtheylbenzene were also detected in the northwest quadrant of Building 5 at concentrations above their industrial soil gas screening level. However, the concentrations of MTBE, TCE, and 1,2,4-trimethylbenzene in sub-slab soil gas samples collected in the northwest quadrant of Building 5 were five to 25 times less than the concentrations of the same compounds detected in sub-slab soil gas samples collected in the northeast quadrant. Except for chloroform in one sample (B5SS-7), the detected concentrations of all other TO-15 compounds in samples collected in the southern half of Building 5 were less than their respective industrial sub-slab soil gas screening level.

Methane

Methane was detected in each sub-slab soil gas sample collected in Building 5. Methane was detected in two samples: (B5SS-1, 4,067,000 µg/m3) and (B5SS-5, 98,400,000 $\mu g/m^3$) at a concentration greater than 10 percent of the methane lower explosive limit (LEL) of 3,280,000 $\mu g/m^3$. The detected concentration of methane in sample B5SS-5 (98,400,000 $\mu g/m^3$) is approximately equal to the upper explosive limit (UEL) of methane (150,000 ppm, 98,405,000 $\mu g/m^3$). The concentration of methane detected in other sub-slab soil gas samples was less than 5,000 $\mu g/m^3$.

4.1.2. First Floor Indoor Air Sampling Results

Validated analytical results for the December 2014 indoor air samples collected on the first floor of Building 5 are provided in **Table 3**. Analytical results are provided for the Building 5 Area COCs as well as other detected TO-15 compounds. The USEPA industrial indoor air screening levels are also provided in **Table 3**. Concentrations that exceed the USEPA industrial air RSL are shaded. The distribution of TO-15 compounds detected in first floor indoor air samples is illustrated in **Figure 8**. Laboratory analytical reports and validation reports are provided on compact disc (CD) in **Appendix C** and **Appendix D**, respectively.

Building 5 Area COCs

Sample results indicate the following Building 5 Area COCs were detected in each of the indoor air samples collected on the first floor of Building 5: toluene, ethylbenzene, xylenes, acetone, IPA, and MIBK. Benzene was detected in four of the indoor air samples collected on the first floor. Methanol was not detected in any indoor air sample.

A comparison of the USEPA industrial indoor air screening levels to the first floor analytical results indicates that the concentration of ethylbenzene, xylene, and IPA were the only Building 5 Area COCs that were detected at concentrations above their USEPA industrial air RSL. The detected concentration of ethylbenzene exceeded its industrial air RSL (4.9 $\mu g/m^3$) in each of the eight indoor air samples. Ethylbenzene concentrations in indoor air ranged from 56 $\mu g/m^3$ in sample B5IA-6 (located along the common wall between Building 5 and Building 6) to 200 $\mu g/m^3$ in sample B5IA-5 (located in northeast quadrant of Building 5) (see **Figure 8**). The detected concentration of xylene exceeded its industrial air RSL (440 $\mu g/m^3$) in three samples (B5IA-1, 460 $\mu g/m^3$), (B5IA-3, 460 $\mu g/m^3$), and (B5IA-5, 773 $\mu g/m^3$). Each of these samples was located in the northern half of Building 5. The IPA concentration in one sample (B5IA-5, 1,000 $\mu g/m^3$), located in the northeast quadrant of Building 5, exceeded its industrial air RSL of 880 $\mu g/m^3$. The maximum detected concentration of all other Building 5 Area COCs was less than their respective industrial indoor air RSL.

The distribution of the Building 5 Area COCs in indoor air was similar to the distribution of the Building 5 Area COCs in the sub-slab soil gas samples. However, the magnitude of the detected concentrations in indoor air samples was significantly less than the magnitude of concentrations detected in the sub-slab soil gas samples. Similar to the sub-slab soil gas results, the highest indoor air concentration of each of the Building 5 Area COCs was detected in samples collected in the northeast quadrant of Building 5 (B5IA-1 or B5-IA-5). Unlike the sub-slab soil gas results, the relative concentrations of the detected Building 5 Area COCs varied significantly less

than the relative concentrations of the Building 5 Area COCs detected in the sub-slab soil gas samples. For example, ethylbenzene concentrations, which ranged from 56 $\mu g/m^3$ to 200 $\mu g/m^3$, varied by less than one order of magnitude across all indoor air samples. Whereas, the ethylbenzene concentrations detected in sub-slab soil gas samples varied by nearly five orders of magnitude, from 18 $\mu g/m^3$ to 1,700,000 $\mu g/m^3$. In addition, a comparison of the sub-slab soil gas concentrations to their co-located indoor air samples indicates significant attenuation of the Building 5 Area COCs between sub-slab soil gas and indoor air. For example, a comparison of the co-located samples B5SS-5 and B5IA-5, indicates the attenuation factor of the Building 5 Area COCs from sub-slab soil gas to indoor air varies from 4,440 for IPA to 9,017 for xylene, with an average attenuation factor of 6,974 for all Building 5 Area COCs.

Other TO-15 Compounds

The validated analytical results for other TO-15 compounds detected in indoor air samples collected on the first floor of Building 5 are provided in **Table 3**. The distribution of other TO-15 compounds detected in the first floor indoor air samples is provided in **Figure 8**. Low-levels of a number of other VOCs were detected in one or more indoor air samples collected in Building 6. A comparison of the USEPA industrial indoor air RSLs to the indoor air analytical results indicates that chloroform was the only other VOC detected above its indoor air RSL. The maximum concentration of all other detected VOCs was less than their respective industrial air RSL. The detected concentration of chloroform slightly exceeded its indoor air RSL of 0.53 $\mu g/m^3$ at each first floor sample location. Detected chloroform concentrations ranged from 1.0 $\mu g/m^3$ in sample B5IA-3 to 1.9 $\mu g/m^3$ in sample B5IA-2.

Methane

Methane was detected in each indoor air sample collected on the first floor of Building 5. The maximum detected concentration of methane in each first floor indoor air sample was less than 10 percent of the methane LEL (3,280,000 $\mu g/m^3$).

4.1.3. Second Floor Indoor Air Sampling Results

Validated analytical results for the December 2014 indoor air samples collected on the second floor of Building 5 are provided in **Table 4**. Analytical results are provided for the Building 5 Area COCs as well as other detected TO-15 compounds. The USEPA industrial indoor air screening levels are also provided in **Table 4**. Concentrations that exceed the USEPA industrial air RSL are shaded. The distribution of TO-15 compounds detected in second floor indoor air samples is illustrated in **Figure 9**. Laboratory analytical reports and validation reports are provided on compact disc (CD) in **Appendix C** and **Appendix D**, respectively.

Building 5 Area COCs

Sample results indicate that the following Building 5 Area COCs were detected in each of the indoor air samples collected on the second floor of Building 5: toluene, ethylbenzene, xylenes, acetone, IPA, and MIBK. Benzene and methanol were not detected in any indoor air sample collected on the second floor.

A comparison of the USEPA industrial indoor air screening levels to the second floor analytical results indicates that ethylbenzene was the only Building 5 COC that was detected at a concentration above its USEPA industrial air RSL. The maximum detected concentration of all other Building 5 Area COCs was less than their respective industrial indoor air RSL. The detected concentration of ethylbenzene exceeded its industrial air RSL (4.9 $\mu g/m^3$) in each of the four indoor air samples collected on the second floor. Ethylbenzene concentrations on the second floor of Building 5 ranged from 9.5 $\mu g/m^3$ in sample B5IA-10 (located in the northwest quadrant of the second floor) to 12 $\mu g/m^3$ in sample B5IA-8 (located in northeast quadrant of the second floor) (see **Figure 9**).

The presence of Building 5 Area COCs on the second floor samples indicates an air connection between the first and second floor of Building 5. A comparison of the second floor results to the first floor results indicates the average concentration of each Building 5 Area COC on the second floor is from seven to nine times less than the average concentration of the same COC on the first floor. This indicates attenuation of the detected Building 5 Area COCs is occurring between the first and second floors of Building 5.

Other TO-15 Compounds

The validated analytical results for other TO-15 compounds detected in indoor air samples collected on the second floor of Building 5 are provided in **Table 4**. The distribution of other TO-15 compounds detected in the second floor indoor air samples is provided in **Figure 9**. Low-levels of a number of other VOCs were detected in one or more indoor air samples collected in Building 6. A comparison of the USEPA industrial indoor air RSLs to the indoor air analytical results indicates that alpha-chlorotoluene was the only other VOC detected above its indoor air RSL. The maximum concentration of all other detected VOCs was less than their respective industrial indoor air RSL. The detected concentration of alpha-chlorotoluene slightly exceeded its indoor air RSL of 0.25 $\mu g/m^3$ in one sample (B5IA-10, 0.56 $\mu g/m^3$) collected on the second floor of Building 5. Note that this constituent was detected in the laboratory method blank (0.52 µg/m3) and was not detected in any of the sub-slab soil gas nor any first floor indoor air samples. Therefore, the detection of alpa-chlorotoluene in sample B5IA-10 is likely attributed to laboratory cross contamination.

Building 5 Area COCs

Sampling results indicate the following Building 5 Area COCs were detected in each sub-soil soil gas sample: toluene, ethylbenzene, xylenes, acetone, IPA, and MIBK. Benzene was detected in four of the five sub-slab soil gas samples and methanol was not detected in any sub-slab soil gas sample.

A comparison of the USEPA industrial soil gas screening levels to the sub-slab soil gas analytical results indicates that ethylbenzene was the only Building 5 COC that was detected at a concentration above its USEPA industrial soil gas screening level underneath Building 6. The maximum detected concentration of all other Building 5 Area COCs was less than their respective industrial soil gas screening level. The detected concentration of ethylbenzene exceeded its industrial soil gas screening level (164 $\mu g/m^3$) at one sample location (B6-2SS, 560 $\mu g/m^3$; duplicate result -450 $\mu g/m^3$). Sample location B6-2SS was located in the warehouse area (see **Figure 10**).

Other TO-15 Compounds

The validated analytical results for other TO-15 compounds detected in the Building 6 sub-slab soil gas samples are also provided in **Table 5**. The distribution of other TO-15 compounds detected in the sub-slab soil gas samples is provided in **Figure 10**. Low-levels of a number of other VOCs were detected in one or more of the sub-slab soil gas samples collected in Building 6. A comparison of the USEPA industrial soil gas screening levels to the sub-slab soil gas analytical results indicates that chloroform and naphthalene were the only other VOCs detected above their industrial soil gas screening level. The maximum concentration of all other detected VOCs was less than their respective industrial soil gas screening level. The detected concentration of chloroform exceeded its industrial soil gas screening level of 18 $\mu g/m^3$ at one sample location (B6-5SS, 30 µg/m3) and naphthalene exceeded its industrial soil gas screening level of 12 $\mu g/m^3$ at one location (B6-2SS, 140 $\mu g/m^3$; duplicate result - 100 $\mu g/m^3$). Sample location B6-5SS was located in the tank room portion of the Water Purification Area and sample location B6-2SS was located in the warehouse area (Room 127) (see **Figure 10**). Sample B6-5SS was located near a floor drain where steam condensate is discharged.

Methane

Methane was detected in each sub-slab soil gas sample collected in Building 6. The maximum detected concentration of methane in each sub-slab soil gas sample was less than 10 percent of the methane LEL (3,280,000 $\mu g/m^3$).

4.2.2. Indoor Air Sampling Results

Validated analytical results for the February-March, and June 2015 Building 6 indoor air samples are provided in **Table 6**. The USEPA industrial indoor air screening levels are also provided in **Table 6**. Concentrations that exceed the USEPA industrial indoor air screening level are shaded. The distribution of TO-15 compounds detected in indoor air samples collected in Building 6 is illustrated in **Figure 11**. Laboratory analytical reports and validation reports are provided on compact disc (CD) in **Appendix C** and **Appendix D**, respectively.

Building 5 Area COCs

Sample results indicate that the following Building 5 Area COCs were detected in each indoor air sample collected within Building 6 during the February-March 2015 sampling: benzene, toluene, ethylbenzene, xylenes, acetone, and IPA. MIBK was detected in three of the four sample locations and methanol was not detected in any indoor air sample. For the June 2015 sampling, the following Building 5 Area COCs were detected in each indoor air sample: toluene, xylenes, acetone, and IPA. Ethylbenzene, MIBK, and methanol were not detected in any indoor air samples collected in June 2015.

A comparison of the USEPA industrial indoor air screening levels to the indoor air analytical results indicates that IPA (first round only) was the only Building 5 Area COC that was detected above its industrial indoor air RSL within Building 6. For both rounds of indoor air sampling in Building 6, the maximum detected concentration of all other Building 5 Area COCs was less than their respective industrial soil gas screening level. Results from the February-March 2015 sampling indicate the detected concentration of IPA exceeded its industrial indoor air RSL of 880 $\mu g/m^3$ in two samples collected in the warehouse area: B6-1IA (3,900 $\mu g/m^3$) and B6-2IA (2,000 $\mu g/m^3$) (see **Figure 11**). As noted in Section 3.1.2, BMSMC has documented that cleaning with IPA had occurred in Building 6 near the warehouse area during the March 2015 sampling. Results of the second round of indoor air sampling performed in the warehouse area in June 2015 indicated the concentration of IPA had decreased significantly to levels well below its industrial air RSL of 880 $\mu g/m^3$. From the June 2015 sampling results, IPA concentrations in the warehouse area ranged from 9.7 $\mu g/m^3$ in sample B6-1IA-2 to 31 $\mu g/m^3$ in sample B6-2IA-2. As also noted in Section 3.1.2, BMSMC has documented that IPA was not being used near the warehouse area during the June 2015 indoor air sampling.

Other TO-15 Compounds

The validated analytical results for other TO-15 compounds detected in the Building 6 indoor air samples are also provided in **Table 6**. The distribution of other TO-15 compounds detected in indoor air samples is provided in **Figure 11**. Low-levels of a number of other VOCs were detected in one or more indoor air samples collected in Building 6. A comparison of the USEPA industrial indoor air RSLs to the indoor air analytical results indicates that chloroform was the only other VOC detected above its indoor air RSL. The maximum concentration of all other detected VOCs was less than their respective industrial air RSL. The detected concentration of chloroform exceeded its indoor air RSL of 0.53 $\mu g/m^3$ at two sample locations in the Water Purification Area: B6-4IA (1.6 µg/m3); and B6-5IA (1.0 µg/m3).

United States Pharmaceutical (USP) purified water is stored in several tanks located within the Water Purification Area (see **Figure 4**). USP Water for Injection Systems is generated within the Water Purification Area by treating raw chlorinated municipal water via reverse osmosis, ion exchange, and distillation. . A review of the 2013 Puerto Rico Aqueduct and Sewer Authority (PRASA) Water Quality Report for Humacao, PR (Public Water Supply ID 5386) indicated trihalomethanes (THMs) are present in Humacao municipal water at concentrations ranging from 16.6 to 68.7 parts per billion (ppb) (PRASA, 2013). Results of a literature review indicates that when THMs are present in raw water, THMs are likely to be also present in product water because THMs are not completely removed during pretreatment operations such as reverse osmosis and ion exchange (Collentro, 2010). Collentro also notes that chloroform is typically the most predominant THM in chlorinated water. Therefore, it is likely the chloroform detected in the indoor air samples collected within the Water Purification Area is due, in total or part, to the volatilization of chloroform from the Building 6 Water Purification Operations.

Methane

Methane was detected in each indoor air sample (both sample rounds) collected in Building 6. The maximum detected concentration of methane in each indoor air sample in both sample rounds was less than 10 percent of the methane LEL (3,280,000 $\mu g/m^3$).

4.2.3. Recommended Path Forward for Building 6

The vapor intrusion pathway in Building 6 is considered a complete pathway based on the criteria provided in Section 1 as defined by the USEPA (USEPA, 2015a). The results of the Building 6 vapor intrusion investigation will be incorporated into the revised Building 5 Area human health risk assessment which will be included in the revised Corrective Measures Study report.

As noted above, except for chloroform, each of the Building 5 Area COCs and each of the other detected TO-15 compounds, is less than their respective industrial indoor air RSL. The detected concentration of chloroform exceeded its indoor air RSL of 0.53 µg/m^3 at two sample locations in the Water Purification Area: B6-4IA (1.6 µg/m3); and B6-5IA (1 µg/m3). Based on an industrial exposure, the estimated carcinogenic risk to a site worker via inhalation of chloroform in the Water Purification Area is $3.0x10^{-6}$ (USEPA, 2015b). This value is at the low end of the USEPA target risk range of 10^{-6} to 10^{-4} (USEPA, 2015a).

The need for and/or path forward for additional Building 6 indoor air assessments will be discussed with the USEPA during our upcoming meeting (September 2015).

4.3. Ambient Air Sampling Results

Validated analytical results for the ambient samples collected during February-March and June 2015 sampling rounds are provided in **Table 7**. For comparison purposes, the USEPA industrial indoor air screening levels are also provided in **Table 7**. Laboratory analytical reports and validation reports are provided on compact disc (CD) in **Appendix C** and **Appendix D**, respectively.

4.3.1. Building 5

Except for methanol, each Building 5 Area COC detected in sub-slab soil gas or indoor air was also detected in ambient air samples during the Building 5 vapor intrusion sampling. Except for bromodichloromethane, bromomethane, 1,1,1-Trichloroethene, and MTBE, all other TO-15 compounds detected in sub-slab soil gas or indoor air samples collected in Building 5 were also detected in ambient air samples. Methane was also detected in ambient air during the Building 5 vapor intrusion sampling.

4.3.2. Building 6

Except for methanol, each Building 5 Area COC detected in sub-slab soil gas or indoor air was also detected in ambient air samples during the Building 6 vapor intrusion sampling. Except for bromoform, bromomethane, and MTBE, all other TO-15 compounds detected in sub-slab soil gas or indoor air samples collected in Building 6 were also detected in ambient air samples. Methane was also detected in ambient air during the Building 6 vapor intrusion sampling.

4.4. Comparison of Building 5 2012 and 2014 Indoor Air Sample Results

Validated analytical results for the 2012 and 2014 indoor air samples collected in Building 5 are presented in **Table 8**. For each sampling event, samples B5IA-1, B5IA-2, B5IA-3, B5IA, and

B5IA-5 were collected at the same location. As noted in the 2012 Vapor Intrusion Investigation Report, analytical results from the July 2012 sampling event were generally higher than the May 2012 sampling event. A comparison of the December 2014 results to previous sampling results indicates the concentration of the Building 5 Area COCs in December 2014 were generally two to four times less than the levels detected in July 2012. This likely indicates improving indoor air quality within Building 5 due to the removal of impacted soil adjacent to Building 5 in 2013 and the resultant ongoing decrease of Building 5 COCs in groundwater near Building 5.

5.0 Summary, Conclusions, and Recommendations

Building 5 Area

- A comprehensive vapor intrusion investigation was completed to determine the potential vapor intrusion at two buildings located within the Building 5 Area (both Building 5 and Building 6).
- The vapor intrusion investigation included a review of past and current building use; completion of indoor building surveys; and collection, and review, and analysis of sub-slab soil gas, indoor air, and ambient air samples.
- All sub-slab soil gas, indoor air, and ambient air samples were analyzed for the full list of USEPA TO-15 compounds plus methane.
- All analytical data were validated and determined to be usable to evaluate the vapor intrusion pathway.

Building 5

- Eight sub-slab soil gas samples (seven locations and one duplicate), eight first floor indoor air samples (seven locations and one duplicate), four second floor indoor air samples, and one ambient air sample were collected for the Building 5 vapor intrusion evaluation.
- The concentration of ethylbenzene, toluene, xylene, acetone, IPA, and MIBK in sub-slab soil gas samples exceeded their USEPA industrial soil gas screening levels.
- The highest sub-slab soil gas concentrations were detected in the northeast quadrant of Building 5.
- As shown in **Figure 7**, the concentration in sub-slab soil gas samples collected in the southern half of Building 5 were each less than their industrial soil gas screening level and two to five orders of magnitude less than the concentrations detected in the northeast quadrant of Building 5. The significant decrease in concentrations in sub-slab soil gas away from the northeast quadrant indicates a localized source of impacted sub-soil gas below the northeast quadrant of Building 5 and rapid attenuation of the COCs beyond the source of impacts.

- Methane was detected in two sub-slab soil gas samples at a concentration greater than 10 percent of the methane LEL of 3,280,000 $\mu g/m^3$. Both of these samples were collected in the northeast quadrant of Building 5. The methane concentration in one of these sub-slab soil gas samples was slightly below the UEL of methane.

- The concentration of ethylbenzene, xylene, and IPA in first floor indoor air samples exceeded their USEPA industrial air RSL. The maximum detected concentration of all other Building 5 Area COCs in first floor indoor air samples, including methane, was less than their respective industrial indoor air RSL.

- Similar to the sub-slab soil gas results, the highest indoor air concentration of each of the Building 5 Area COCs was detected in samples collected in the northeast quadrant of Building 5.

- A comparison of the sub-slab soil gas concentrations to their co-located first floor indoor air samples indicates significant attenuation of the Building 5 Area COCs between sub-slab soil gas and indoor air.

- Ethylbenzene was the only Building 5 Area COC that was detected in second floor indoor air samples at a concentration above its USEPA industrial air RSL.

- A comparison of the second floor indoor air results to the first floor indoor air results indicates attenuation of the detected Building 5 Area COCs is occurring between the first and second floors of Building 5.

- Except for bromodichloromethane, bromomethane, 1,1,1-Trichloroethene, and MTBE, all Building 5 Area COCs, including methane, and all other TO-15 compounds detected in sub-slab soil gas or indoor air samples collected in Building 5, were also detected in ambient air samples (albeit at lower concentrations).

- The vapor intrusion pathway for Building 5 is considered incomplete, since the building is currently unused and vacant. However, if the use of Building 5 changes in the future such that it becomes an occupied space, then the vapor intrusion pathway will be considered complete and BMSMC will re-evaluate the vapor intrusion pathway and implement appropriate mitigation controls as necessary to protect the health and safety of potential receptors.

- The results of the Building 5 vapor intrusion investigation will be incorporated into the revised Building 5 Area human health risk assessment which will be included in the revised Corrective Measures Study report.

- A comparison of the December 2014 indoor air results to previous sampling results indicates the concentration of the Building 5 Area COCs in December 2014 were generally two to four times less than the indoor air levels detected in July 2012. This likely indicates improving indoor air quality within Building 5 due to the removal of impacted soil adjacent to Building 5 in 2013 and the resultant ongoing decrease of Building 5 COCs in groundwater near Building 5.

- The Building 5 vapor intrusion evaluation is considered finalized and no additional vapor intrusion investigation activities are needed in Building 5.

Building 6

- Seven sub-slab soil gas samples (five locations with two duplicate samples), ten indoor samples collected over two sampling events, and two ambient air samples were collected for the Building 6 vapor intrusion evaluation.

- Ethylbenzene was the only Building 5 Area COC that was detected in sub-slab soil gas samples at a concentration above its USEPA industrial soil gas screening level. The maximum detected concentration of all other Building 5 Area COCs in sub-slab soil gas samples, including methane, was less than their respective industrial soil gas screening level.

- Chloroform and naphthalene were the only other VOCs detected in sub-slab soil gas samples above their industrial soil gas screening level. The maximum concentration of all other detected VOCs was less than their respective industrial soil gas screening level.

- IPA (first round only) was the only Building 5 Area COC that was detected in indoor air samples above its industrial indoor air RSL. BMSMC has documented that cleaning with IPA had occurred in Building 6 near the warehouse area during the first round of sampling.

- Results of the second round of indoor air sampling performed in the warehouse area in June 2015 indicated the concentration of IPA had decreased significantly to levels well below its industrial air RSL. BMSMC has documented that IPA was not being used near the warehouse area during the June 2015 indoor air sampling.

- For both rounds of indoor air sampling in Building 6, the maximum detected concentration of all other Building 5 Area COCs, including methane, was less than their respective industrial indoor air screening level.

- Except for bromoform, bromomethane, and MTBE, all Building 5 Area COCs, including methane, and all other TO-15 compounds detected in sub-slab soil gas or indoor air samples collected in Building 6, were also detected in ambient air samples.

- The vapor intrusion pathway in Building 6 is considered a complete pathway based on the criteria provided in Section 1 as defined by the USEPA. Except for chloroform, each of the Building 5 Area COCs and each of the other detected TO-15 compounds, is less than their respective industrial indoor air RSL.

- Based on an industrial exposure, the estimated carcinogenic risk to a site worker via inhalation of chloroform in the Water Purification Area is 3.0×10^{-6} (USEPA, 2015b). This value is at the low end of the USEPA target risk range of 10^{-6} to 10^{-4}.

- It is likely the chloroform detected in the indoor air samples collected within the Water Purification Area is due, in total or part, to the volatilization of chloroform from the Building 6 Water Purification Operations.

- The results of the Building 6 vapor intrusion investigation will be incorporated into the revised Building 5 Area human health risk assessment which will be included in the revised Corrective Measures Study report.

- The need for and/or path forward for additional Building 6 indoor air assessments will be discussed with the USEPA during our upcoming meeting (September 2015).

6.0 References

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Table 2
Building 5 Sub-Slab Soil Gas Sample Results
Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

Compound	USEPA June 2015 Soil Gas Screening Level[1]	B5SS-1 Dec-14	B5SS-1D Dec-14	B5SS-2 Dec-14	B5SS-3 Dec-14	B5SS-4 Dec-14	B5SS-5 Dec-14	B5SS-6 Dec-14	B5SS-7 Dec-14
Building 5 Area COCs (ug/m^3)									
Benzene	52	<9,600 (0.15)	<9,300 (0.15)	<3.4	<940 (0.15)	<4.1	<14,000 (0.15)	<3.8	<3.9
Toluene	730,000	600,000	210,000	24	1,600	240	8,300,000	19	14
Ethylbenzene	160	130,000	41,000	44	2,000	40	1,700,000	18	81
Xylenes	15,000	860,000	256,000	90	8,700	175	6,970,000	15	356
Acetone	4,500,000	4,300,000	2,100,000	210	93,000	300	6,800,000	52	110
Isopropyl Alcohol	29,000	6,500,000	3,200,000	69	300,000	120	4,400,000	17	<12
MIBK	440,000	1,200,000	460,000	21	5,100	100	5,100,000	16	130
Methanol	2,900,000	<160,000	<150,000	<140	320	<170	<160,000	<160	<160
Methane[2]	3,280,000	4,067,000	2,821,000	<1,440	4,790	3,740	98,405,000	<1,570	<1,570
Other TO-15 Compounds Detected (ug/m^3)									
Bromodichloromethane	11	<20,000 (0.43)	<20,000 (0.43)	<7.2	<2,000 (0.43)	<8.6	<29,000 (0.43)	<8.0	3.5 J
Bromomethane	730	<12,000 (1.1)	<11,000 (1.1)	11 J	<1,100 (1.1)	13 J	<16,000 (1.1)	10 J	14 J
1,3-Butadiene	14	<6,600 (0.57)	<6,400 (0.57)	1.2 J	<650 (0.57)	<2.8	<9,400 (0.57)	<2.6	<2.7
2-Butanone	730,000	<36,000	<34,000	33	<3,500	8.0 J	<50,000	6.9 J	13 J
Carbon Disulfide	100,000	<9,400	<9,100	<13	<920	3.2 J	<13,000	12 J	7.1 J
Chlorobenzene	7300	21,000	<13,000 (0.46)	<5.0	1,500	<5.9	18,000 J	<5.5	<5.6
Chloroform	18	<15,000 (0.33)	<14,000 (0.33)	<5.3	<1,400 (0.33)	1.2 J	<21,000 (0.33)	<5.8	160
Cumene	58,000	<15,000	<14,000	<5.3	<1,400	0.96 J	<21,000	<5.9	<6.0
Ethanol	NA	14,000,000 E, J	7,700,000 E, J	89	400,000	250	9,100,000 E, J	48	53
4-Ethyltoluene	NA	5,200 J	<14,000	<5.3	780 J	<6.3	6,200 J	<5.9	<6.0
Freon 11	100,000	<17,000	<16,000	1.3 J	<1,600	460	<24,000	2.4 J	49
Freon 12	15,000	<15,000	<14,000	2.2 J	<1,400	2.9 J	<21,000 (0.52)	2.9 J	3.0 J
Heptane	NA	14,000	5,400 J	<4.4	<1,200	4.6 J	94,000	<4.9	<5.0
Hexane	100,000	<11,000	<10,000	<3.8	<1,000	1.0 J	<15,000	<4.2	<4.3
Methyl tert-butyl ether	1,600	25,000 J	16,000 J	1.6 J	3,500 J	2.8 J	85,000 J	<4.3	3.8 J
Methylene Chloride	41,000	960,000 J	640,000 J	5.8 J	720 J	92	5,100,000	8.5 J	4.3 J
Naphthalene	12	<63,000 (0.18) R	<61,000 (0.18) R	<11 R	<6,200 (0.18) R	0.82 J	<90,000 (0.18) R	<12	<13 (0.18)
Styrene	150,000	<13,000	<12,000	<4.6	<1,200	1.5 J	<18,000	<5.1	<5.2
Tetrachloroethene	1,600	12,000 J	<20,000 (0.76)	<7.3	<2,000 (0.76)	<8.7	9,600 J	<8.1	<8.2
Tetrahydrofuran	290,000	20,000	7,400 J	<3.2	<870	4.7	99,000	<3.5	1.2 J
1,2,4-Trichlorobenzene	290	<89,000 (1.5)	<86,000 (1.5)	<32	<8,800 (1.5)	6.4 J	<130,000 (1.5)	<36	<36
1,1,1-Trichloroethane	730,000	<16,000	<16,000	<5.9	<1,600	8.8	<23,000	<6.5	<6.6
Trichloroethene	100	24,000	<16,000 (0.51)	<5.8	2,700	<6.9	10,000 J	<6.4	<6.5
1,2,4-Trimethylbenzene	1,000	6,800 J	<14,000 (0.31)	<5.3	1,100 J	1.0 J	5,500 J	<5.9	<6.0
1,3,5-Trimethylbenzene	NA	<15,000	<14,000	<5.3	350 J	<6.3	<21,000	<5.9	<6.0

Notes:

Concentrations above the USEPA Screening Level are shaded.

[1]USEPA Vapor Intrusion Screening Level Calculator Version 3.4, June 2015 RSLs.

[2]Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015)

NA: USEPA has not developed a screening level for this compound for this medium

Non-detect results are reported as "<" the reporting limit.

The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.

E - Exceeds instrument calibration range

J - Estimated value

R - Rejected by data validator because recovery in laboratory control sample less than 70%

Table 3
Building 5 First Floor Indoor Air Sample Results
Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

Compound	USEPA Industrial Indoor Air Screening Level[1]	B5IA-1 Dec-14	B5IA-2 Dec-14	B5IA-3 Dec-14	B5IA-3D Dec-14	B5IA-4 Dec-14	B5IA-5 Dec-14	B5IA-6 Dec-14	B5IA-7 Dec-14
Building 5 Area COCs (ug/m^3)									
Benzene	1.6	<1.1	1.3	<0.95	<0.92	0.57	<2.5 (0.080)	0.70	0.74
Toluene	22,000	730 E	450 E	710 E	570 E	520 E	1,300 E	370 E	520 E
Ethylbenzene	4.9	110	71	120	95	85	200	56	81
Xylenes	440	460	285	460	371	328	773	218	317
Acetone	140,000	820 E	510 E	750 E	650 E	570 E	1,400 E	510 E	580 E
Isopropyl Alcohol	880	510 E	380 E	500 E	410 E	400 E	1,000 E	380 E	400 E
MIBK	13,000	440	250	410	320	290 E	660	210	290
Methanol	88,000	<110	<110	<98	<190	<110	<100	<100	<120
Methane[2]	3,280,000	9,180	6,560	9,180	7,870	7,870	12,460	5,900	7,870
Other TO-15 Compounds Detected (ug/m^3)									
1,3-Butadiene	0.41	<0.76 (0.062)	0.12 J	<0.66 (0.062)	<0.63 (0.062)	<0.38	<1.7 (0.062)	<0.35	<0.39
2-Butanone	22,000	2.6 J	2.8	2.4 J	2.6 J	2.5 J	<12	2.9	2.6
Carbon Disulfide	3,100	<5.3	14	<4.6	<4.5	<2.7	<12	1.1 J	<2.8
Carbon Tetrachloride	2.0	<2.2 (0.11)	<1.1	<1.9	<1.8	<1.1	<5.0 (0.11)	0.66 J	<1.1
Chloroform	0.53	1.8	1.9	1.0 J	1.2 J	1.6	1.3 J	1.8	1.6
Chloromethane	390	1.6 J	1.8	1.7 J	2.1 J	1.9	1.9 J	1.8	1.8 J
Cyclohexane	26,000	<1.2	0.3 J	0.41 J	<0.99	0.32 J	<2.7	0.47 J	0.38 J
1,4-Dichlorobenzene	1.1	<2.0 UJ (0.27)	<1.0 UJ	<1.8 UJ (0.27)	<1.7 UJ (0.27)	<1.0 UJ	<4.8 UJ (0.27)	<0.95 UJ	0.30 J
1,4-Dioxane	2.5	<1.2	0.47 J	<1.1	<1.0	<0.63	<2.8 (0.12)	<0.57	<0.64
Ethanol	NA	1,100 J, E	600 J, E	1,000 J, E	830 J, E	680 J, E	2,700 J, E	520 J, E	720 J, E
4-Ethyltoluene	NA	0.88 J	0.70 J	0.90 J	0.59 J	0.87	1.4 J	0.53 J	0.65 J
Freon 11	3,100	1.2 J	1.0	1.1 J	1.2 J	1.1	<4.4	1.0	1.1
Freon 113	130,000	<2.6	0.35 J	0.46 J	<2.2	0.55 J	<6.0	0.38 J	0.39 J
Freon 12	440	1.8 J	2.4 J	2.1 J	2.2 J	2.0 J	<20	2.3 J	2.3 J
Heptane	NA	15	9.7	15	13	12	29	8.8	11
Hexane	3,100	0.74 J	0.70	0.66 J	0.92 J	1.5	<2.8	1.1	0.80
2-Hexanone	130	<7.0	<3.6	<6.1	<5.9	<3.6	<16	<3.2	0.68 J
Methyl tert-butyl ether	47	7.4	4.2	7.1	6.2	5.0	13	3.5	5.3
Methylene Chloride	1,200	330	180	310	260	220	590	160	230
Propylbenzene	4,400	<1.7	<0.86	<1.5	<1.4	0.19 J	<3.9	<0.78	<0.88
Styrene	4,400	4.0	3.7	3.6	3.0	3.4	4.1	2.3	3.6
Tetrachloroethene	47	<2.3	<1.2	<2.0	<1.9	<1.2	<5.4	5.0	<1.2
Tetrahydrofuran	8,800	15	8.6	14	12	10	23	7.8	10
1,2,4-Trimethylbenzene	31	2.4	1.9	2.0	1.5 J	1.9	2.1 J	1.6	2.0
2,2,4-Trimethylpentane	NA	<8.0	0.67 J	<7.0 J	1.3 J	0.79 J	<18	0.64 J	0.64 J

Notes:

Concentrations above the USEPA Screening Level are shaded.

[1]USEPA Regional Screening Levels, June 2015.

[2]Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015)

NA: USEPA has not developed a screening level for this compound for this medium

Non-detect results are reported as "<" the reporting limit.

The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.

E - Exceeds instrument calibration range

J - Estimated value

UJ - Analyte associated with low bias in the CCV and/or LCS

Table 4
Building 5 Second Floor Indoor Air Sample Results
Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

Compound	USEPA Industrial Indoor Air Screening Level[1]	B5IA-8 Dec-14	B5IA-9 Dec-14	B5IA-10 Dec-14	B5IA-11 Dec-14
Building 5 Area COCs (ug/m^3)					
Benzene	1.6	<0.55	<0.51	<0.58	<0.58
Toluene	22,000	80	72	64	71
Ethylbenzene	4.9	12	11	9.5	11
Xylenes	440	48.5	44	38	43.3
Acetone	140,000	100	100	86	92
Isopropyl Alcohol	880	73	70	61	70
MIBK	13,000	43	36	34	37
Methanol	88,000	<110	<100	<120	<120
Methane[2]	3,280,000	2,160	2,100	2,100	2,030
Other TO-15 Compounds Detected (ug/m^3)					
1,3-Butadiene	0.41	0.12 J	<0.36	<0.4	<0.4
2-Butanone	22,000	1.8 J	2.4	1.7 J	2.1 J
Carbon Disulfide	3,100	<2.7	<2.5	5.4	<2.8
Carbon Tetrachloride	2.0	0.5 J	0.62 J	<1.1	0.48 J
Chloroform	0.53	0.24 J	0.47 J	0.22 J	0.28 J
Chloromethane	390	1.8 J	2.0	1.6 J	1.7 J
alpha-Chlorotoluene	0.25	<4.5 UJ (0.33)	<4.2 UJ (0.33)	0.56 J	<4.7 UJ (0.33)
1,4-Dichlorobenzene	1.1	<1.0 UJ	<0.97 UJ	0.16 J	<1.1 UJ
1,4-Dioxane	2.5	<0.62	<0.58	1.0	0.43 J
Ethanol	NA	130 J	120 J	100 J	120 J
4-Ethyltoluene	NA	0.38 J	0.34 J	0.48 J	0.48 J
Freon 11	3,100	1.2	1.1	1.2	1.2
Freon 113	130,000	0.41 J	0.52 J	0.44 J	0.36 J
Freon 12	440	2.3 J	2.5 J	2.4 J	2.4 J
Heptane	NA	1.8	1.8	1.5	1.6
Hexane	3,100	0.58 J	0.70	0.56 J	0.61 J
2-Hexanone	130	<3.5	0.51 J	<3.7	<3.7
Methyl tert-butyl ether	47	0.91	0.81	0.80	0.77
Methylene Chloride	1,200	36	33	28	31
Styrene	4,400	0.65 J	0.72	0.57 J	0.64 J
Tetrahydrofuran	8,800	2.1 J	1.7 J	1.3 J	1.7 J
1,2,4-Trimethylbenzene	31	0.84 J	0.66 J	0.70 J	0.57 J
2,2,4-Trimethylpentane	NA	2.6 J	3.5 J	2.5 J	3.9 J

Notes:

Concentrations above the USEPA Screening Level are shaded.

[1]USEPA Regional Screening Levels, June 2015.

[2]Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015)

NA: USEPA has not developed a screening level for this compound for this medium

Non-detect results are reported as "<" the reporting limit.

The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level

J - Estimated value

UJ - Analyte associated with low bias in the CCV and/or LCS

Table 5
Building 6 Sub-Slab Soil Gas Sample Results
Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

Compound	USEPA June 2015	B6-1SS	B6-2SS	B6-2SSDup	B6-3SS	B6-3SSD	B6-4SS	B6-5SS
		Mar-15	Mar-15	Mar-15	Feb-15	Feb-15	Feb-15	Feb-15
		Warehouse Room 127			Office Room 188A		WPA-South	WPA-North
Building 5 Area COCs (ug/m^3)								
Benzene	52	3.9 J	1.0 J	<7.8	13 J	3.7 J	<4.0	6.1 J
Toluene	730,000	11 J	7.0	6.4 J	25	26	9.5	3,300
Ethylbenzene	160	3.2 J	560	450	54	57	8.0	59
Xylenes	15,000	42	2,170	1,700	7.7	6.1	66	219
Acetone	4,500,000	330	390	320	180	180	400	360
Isopropyl Alcohol	29,000	2,400	530 J	1,600 J	140	150	4,700 E	960
MIBK	440,000	5.4 J	14	12	2.7	2.8	1.8 J	150
Methanol	2,900,000	<150	<150	<160	<150	<150	<160	<160
Methane[2]	3,280,000	920	1,120	1,050	1,250	1,440	1,380	2,490
Other TO-15 Compounds Detected (ug/m^3)								
Bromoform	370	9.0 J	<15	<25	<2.4	<2.4	<13	<25
2-Butanone	730,000	<40	270	210	14	14	4.7 J	10 J
Carbon Disulfide	100,000	7.9 J	6.6 J	<30 J	0.65 J	<3.6	<19	21 J
Carbon Tetrachloride	68	<21	<9.4	<15	0.58 J	0.49 J	<7.8	<15
Chlorobenzene	7,300	<15	<6.9	<11	0.50 J	0.55 J	<5.7	<11
Chloroform	18	18	14	11 J	0.32 J	0.24 J	1.2 J	30
Chloromethane	13,000	<69	<31	<50	1.5 J	1.5 J	2.2 J	4.7 J
Cumene	58,000	<16	4.9 J	4.0 J	0.51 J	0.29 J	1.5 J	4.8 J
Cyclohexane	880,000	1.9 J	1.2 J	<8.4	3.3 J	1.3 J	<4.3	<8.3
trans-1,2-Dichloroethene	NA	<13	<5.9	<9.6	<0.91	0.25 J	<4.9	<9.6
1,4-Dioxane	82	<48	<22	<35	0.62 J	0.80 J	<4.5	<8.7
Ethanol	NA	35	27	37	30 J	30 J	170 J	1,200 J
4-Ethyltoluene	NA	12 J	22	17	1.0 J	1.0 J	12	26
Freon 11	100,000	7.8 J	2.9 J	<14 J	0.99 J	1.2 J	<7.0	<14
Freon 113	4,400,000	<26	<11	<19	0.45 J	0.45 J	<9.5	<18
Freon 12	15,000	<17	2.4 J	<12	2.2	2.3	<6.1	<12
Heptane	NA	<14	<6.1	<10	3.1 J	1.1 J	<5.1	380
Hexane	100,000	6.7 J	<5.3	<8.6	4.3 J	1.8 J	4.0 J	5.2 J
2-Hexanone	4,400	<55	<24	<40	<4.7 J	1.4 J	<25	<50
Methyl tert-butyl ether	1,600	<12	<5.4	<8.8	7.6	8.7	<4.5	760
Methylene Chloride	41,000	<120	<52	<84	3.5	3.6	3.7 J	21

Table 6
Building 6 Indoor Air Sample Results
Building 5 Area (SWMU 20) Vapor Intrusion Investigation Report
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

Compound	USEPA Industrial Indoor Air Screening Level[1]	B6-1IA	B6-1IA-2	B6-2IA	B6-2IADup	B6-2IA-2	B6-2IAD-2	B6-3IA	B6-3IAD	B6-4IA	B6-5IA
		Mar-15	Jun-15	Mar-15	Mar-15	Jun-15	Jun-15	Feb-15	Feb-15	Feb-15	Feb-15
		Warehouse Room 127						Office Room 188A		WPA-South	WPA-North
Building 5 Area COCs (ug/m^3)											
Benzene	1.6	0.32 J	<0.51	0.84 J	0.36 J	<0.53	<0.49	0.33 J	0.32 J	0.28 J	0.37 J
Toluene	22,000	1.7	0.67	2.6	2.2	0.87	0.93	8.7	6.7	6.3	8.2
Ethylbenzene	4.9	0.46 J	<0.69	0.60 J	0.58 J	<0.72	<0.66	0.20 J	0.20 J	0.74	1.1
Xylenes	440	1 J	0.19 J	1.9	1.73	0.16 J	0.16 J	0.90 J	0.82 J	2.92	4.54
Acetone	140,000	18 J	4.9	31 J	17 J	13	7.7	19	16	22	16
Isopropyl Alcohol	880	3,900	9.7	2,000	2,100	31	32	120	120	89	39
MIBK	13,000	0.40 J	<0.65	0.82 J	0.68 J	<0.68	<0.63	<0.64	<0.72	1.5	3.0
Methanol	88,000	<100	<100	<100	<110	<110	<100	<100	<120	<110	<110
Methane[2]	3,280,000	1,120	1,250	1,180	1,640	1,310	1,250	1,250	1,310	1,440	1,440
Other TO-15 Compounds Detected (ug/m^3)											
Bromomethane	22	0.73 J	<3.1	<5.1	<5.3	<3.2	<3.0	<3.0	<3.4	<3.1	<3.4
1,3-Butadiene	0.41	<0.86 (0.062)	<0.35	0.21 J	<0.60 (0.062)	<0.37	<0.34	<0.35	<0.39	<0.36	<0.38
2-Butanone	22,000	0.77 J	0.64 J	1.4 J	1.0 J	0.86 J	0.91 J	0.87 J	<2.6	1.5 J	0.92 J
Carbon Tetrachloride	2.0	0.61 J	0.65 J	0.56 J	0.56 J	0.82 J	0.68 J	0.40 J	0.48 J	0.52 J	0.55 J
Chloroform	0.53	<1.9 (0.12)	<0.78 (0.12)	<1.3 (0.12)	<1.3 (0.12)	<0.81 (0.12)	<0.75 (0.12)	<0.77 (0.12)	<0.86 (0.12)	1.6	1.0
Chloromethane	390	1.3 J	1.4 J	1.4 J	1.2 J	1.4 J	1.4 J	1.4 J	1.4 J	1.5 J	1.5 J
Cyclohexane	26,000	<1.3	1.9	<0.91	<0.94	3.4	3.4	0.20 J	<0.6	<0.56	<0.60
1,4-Dichlorobenzene	1.1	<2.3 (0.27)	<0.96	<1.6 (0.27)	<1.6 (0.27)	<1.0	<0.92	<0.94	<1.0	<0.97	0.20 J
Ethanol	NA	23	48	38	31	28	29	23	20	7.9	9.8
4-Ethyltoluene	NA	0.40 J	0.24 J	0.55 J	0.52 J	0.27 J	0.39 J	<0.77	<0.86	<0.8	<0.85
Freon 11	3,100	1.1 J	1.3	1.2 J	1.2 J	1.3	1.3	1.1	1.1	1.4	1.2
Freon 113	130,000	<3.0	0.49 J	<2.0	0.43 J	0.52 J	0.45 J	0.49 J	0.53 J	0.49 J	0.55 J
Freon 12	440	2.3	2.4	2.2	2.3	2.4	2.4	2.2	2.2	2.2	2.4
Heptane	NA	<1.6	0.82	0.36 J	0.19 J	2.2	2.3	0.24 J	0.29 J	0.30 J	0.36 J
Hexane	3,100	<1.4	0.10 J	0.29 J	0.29 J	0.14 J	0.18 J	6.4	5.0	2.7	1.2
Methylene Chloride	1,200	0.53 J	0.61 J	0.83 J	0.83 J	0.72 J	0.75 J	0.40 J	0.61 J	2.2	3.7
Naphthalene	0.36	<10 (0.33)	<4.2 (0.33)	0.29 J	0.27 J	<4.4 (0.33)	<4.0 (0.33)	<4.1 (0.33)	<4.6 (0.33)	<4.2 (0.33)	<4.5 (0.33)
Propylbenzene	4,400	<1.9	<0.78	<1.3	0.19 J	<0.82	0.14 J	<0.77	<0.86	<0.80	<0.85
Styrene	4,400	<1.7	<0.68	<1.1	<1.2	<0.71	<0.65	0.16 J	<0.75	<0.69	<0.74
Tetrahydrofuran	8,800	<5.8	<2.3	1.2 J	0.88 J	<2.4	<2.2	<2.3	<2.6	<2.4	<2.6
Trichloroethene	3.0	<2.1	<0.85	<1.4	<1.5	0.24 J	0.23 J	<0.84	<0.94	<0.87	<0.93
1,2,4-Trimethylbenzene	31	0.31 J	0.26 J	0.51 J	0.54 J	0.34 J	0.33 J	0.28 J	0.33 J	<0.80	0.32 J
1,3,5-Trimethylbenzene	NA	<1.9	<0.78	<1.3	0.22 J	<0.82	<0.75	<0.77	<0.86	<0.80	<0.85
2,2,4-Trimethylpentane	NA	<9.1	<3.7	<6.2	<6.4	0.31 J	0.29 J	<3.7	<4.1	<3.8	<4.0

Notes:

Concentrations above the USEPA Screening Level are shaded.

[1]USEPA Regional Screening Levels, June 2015.

[2]Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015)

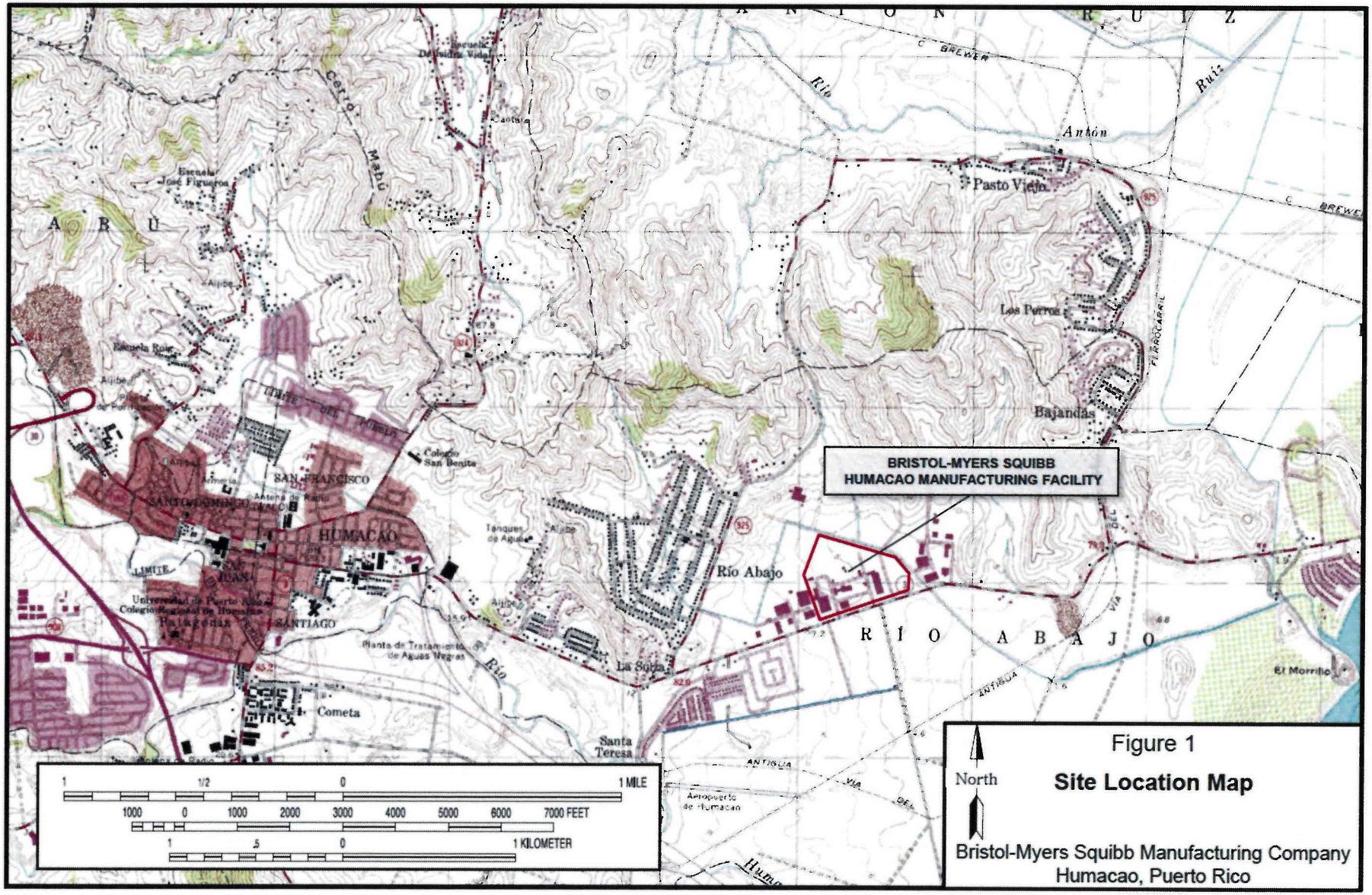
NA: USEPA has not developed a screening level for this compound for this medium

Non-detect results are reported as "<" the reporting limit.

The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.

E - Exceeds instrument calibration range

J - Estimated value



Source: U.S. Geological Survey. Humacao Quadrangle, Puerto Rico. 1:24,000. 7.5 Minute Series. Reston, VA: United States Department of the Interior, USGS, 1967, Photorevised 1982.

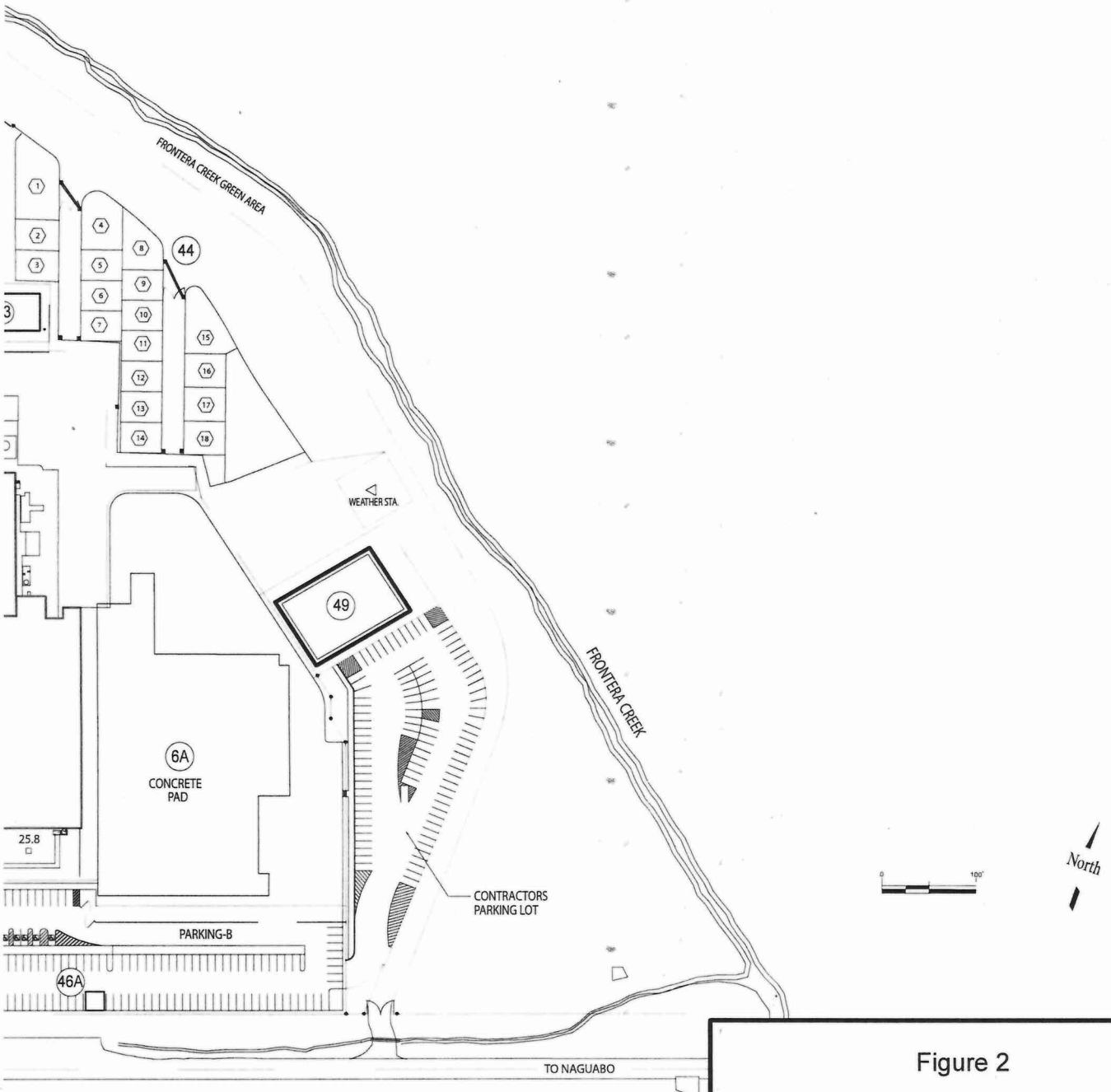
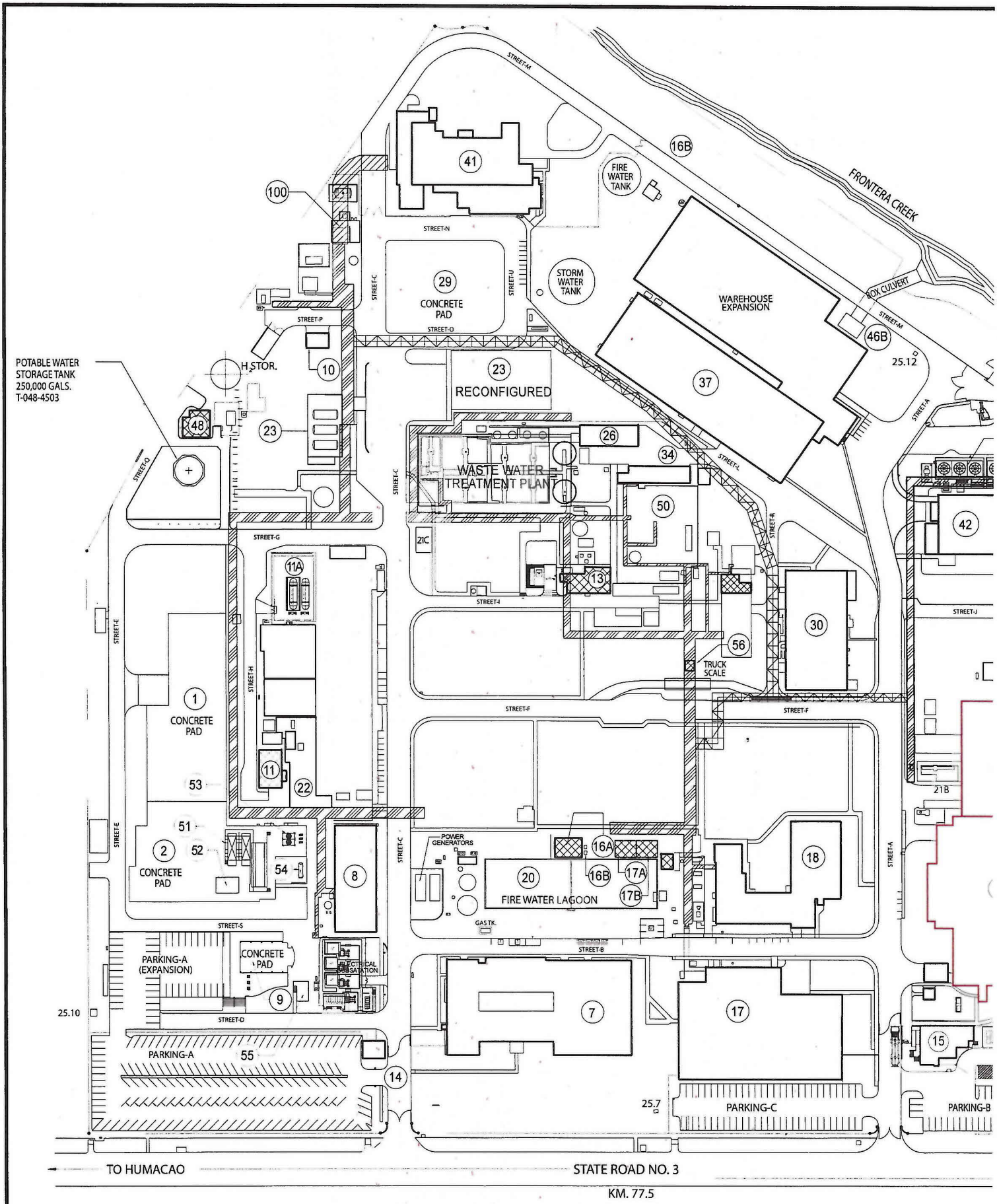


Figure 2

BMS Humacao - Site Layout

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico


FRONTERA CREEK
STREET-M
16B
41
FIRE WATER TANK
100
STREET-N
29
CONCRETE PAD
STREET-C
STREET-J
STORM WATER TANK
WAREHOUSE EXPANSION
BOX CULVERT
46B
25.12
STREET-P
STREET-O
POTABLE WATER STORAGE TANK 250,000 GALS. T-048-4503
H.STOR.
10
23
RECONFIGURED
48
37
26
34
STREET-L
STREET-A
WASTE WATER TREATMENT PLANT
50
42
STREET-G
STREET-Q
21C
STREET-H
11A
13
STREET-I
STREET-J
30
56
TRUCK SCALE
STREET-E
1
CONCRETE PAD
STREET-F
53
11
22
21B
51
2
52
CONCRETE PAD
54
8
POWER GENERATORS
16A
16B
17A
17B
20
FIRE WATER LAGOON
18
GAS TK.
STREET-S
STREET-B
PARKING-A (EXPANSION)
CONCRETE PAD
ELECTRICAL SUBSTATION
9
25.10
STREET-D
7
17
15
PARKING-A
55
14
25.7
PARKING-C
PARKING-B
TO HUMACAO
STATE ROAD NO. 3
KM. 77.5

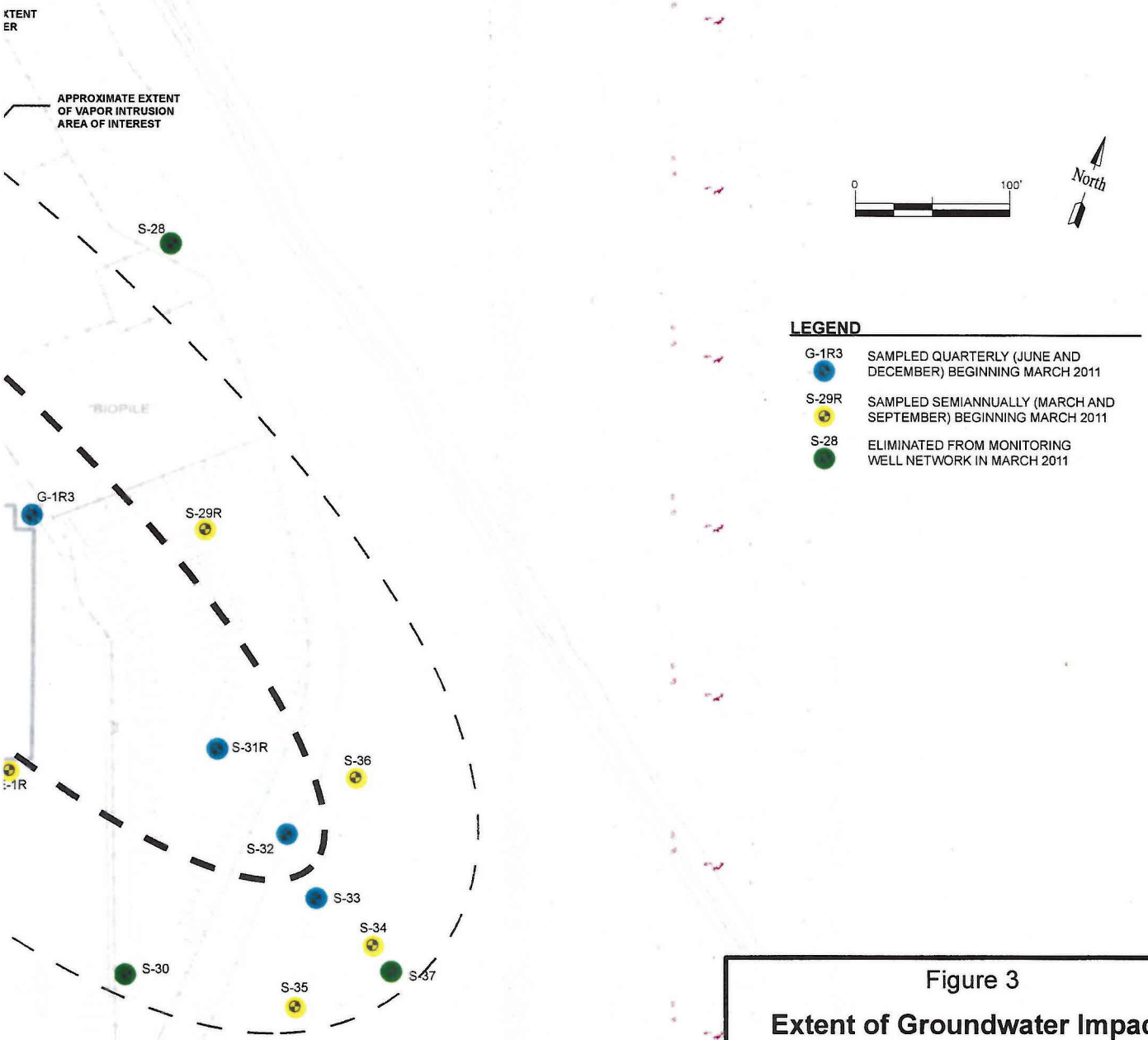
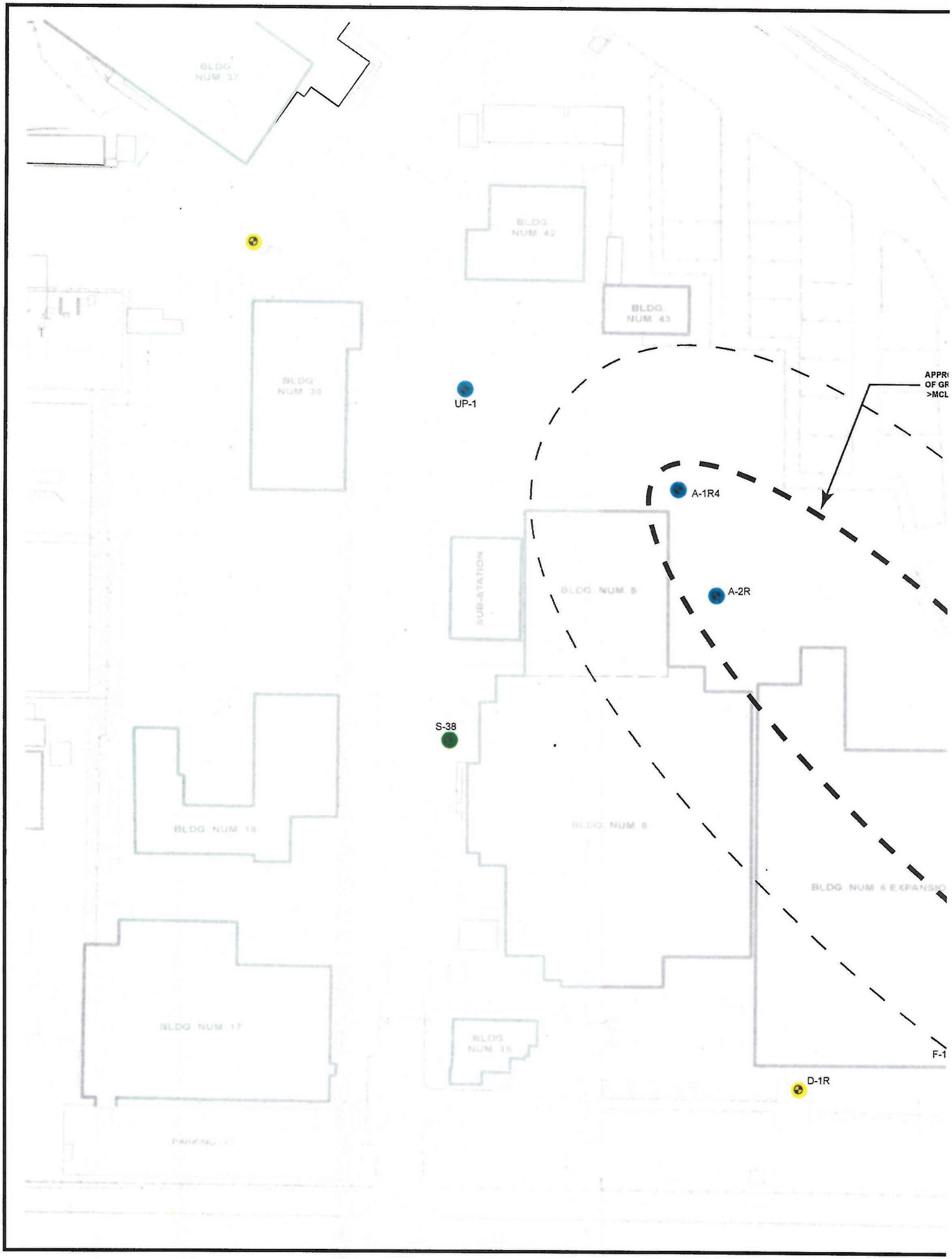
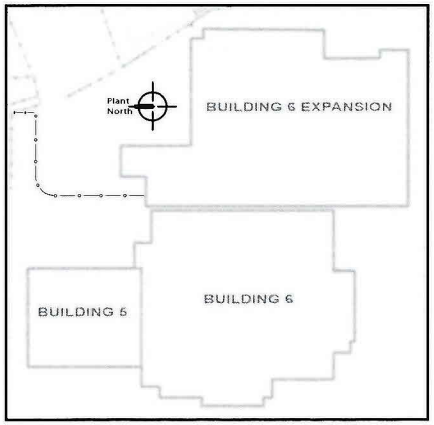


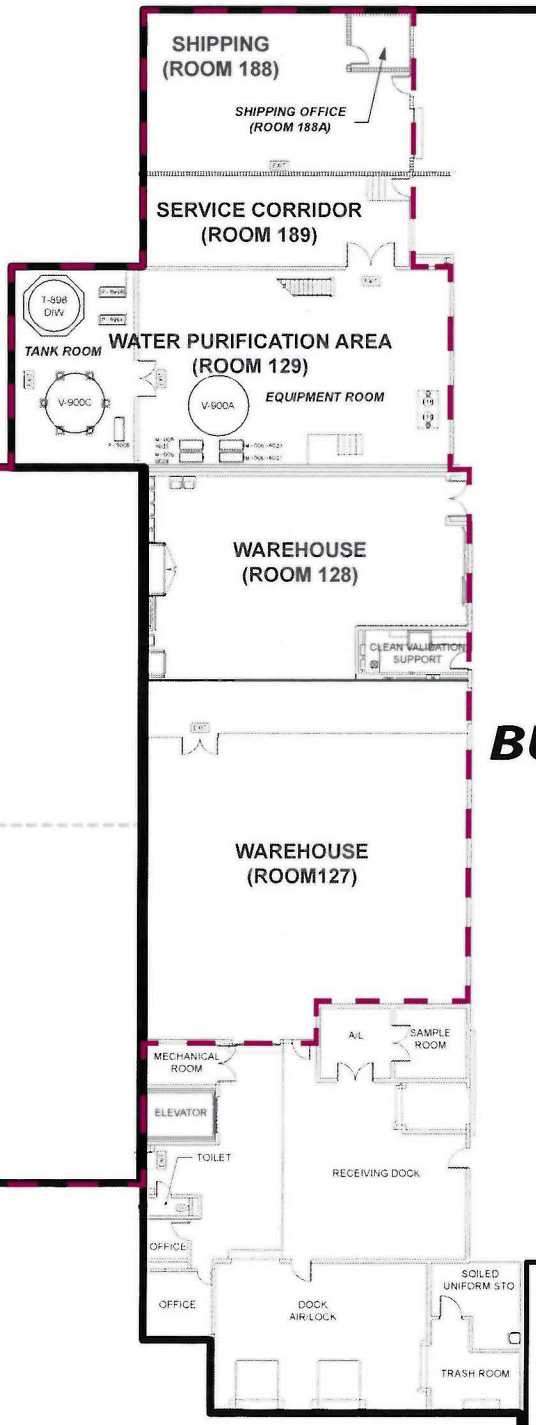
Figure 3

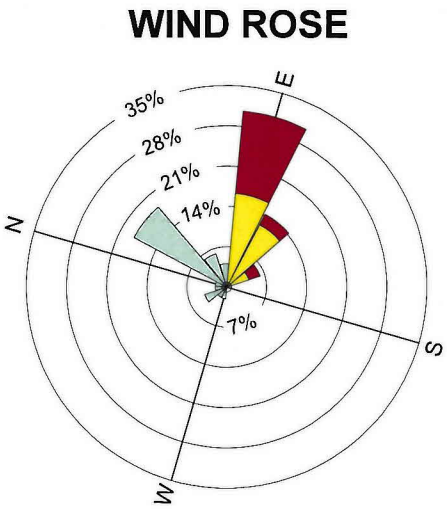
Extent of Groundwater Impacts Building 5 Area

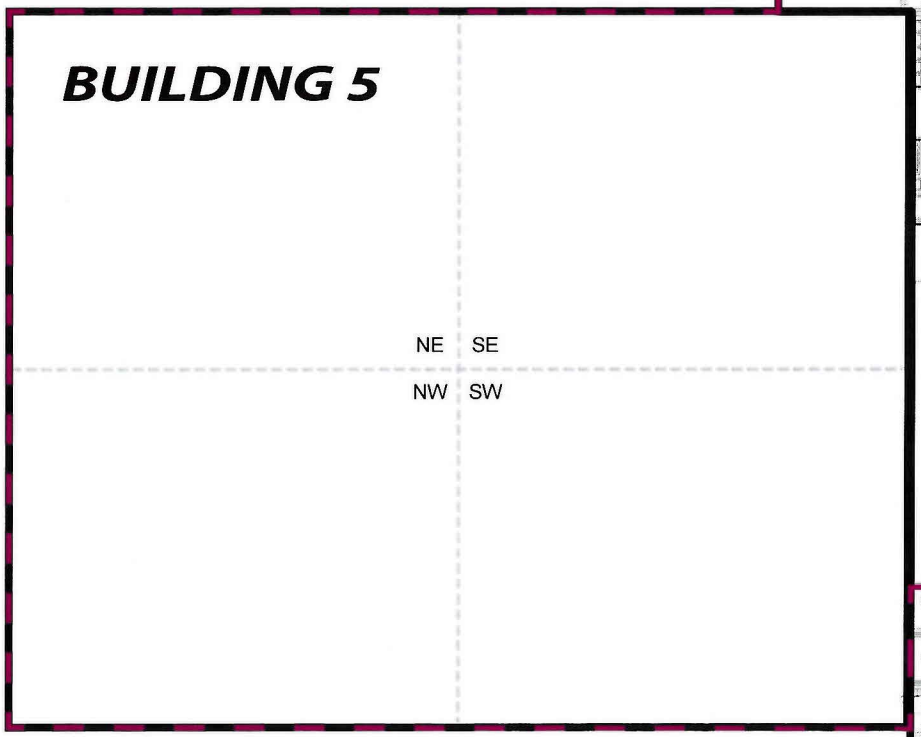
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

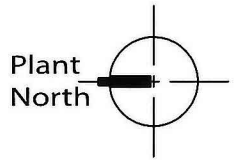

BLDG NUM 37
BLDG NUM 42
BLDG NUM 43
BLDG NUM 30
UP-1
APPR
OF GR
>MCL
A-1R4
SUB-STATION
BLDG NUM 5
A-2R
S-38
BLDG NUM 18
BLDG NUM 6
BLDG NUM 6 EXPANSIO
BLDG NUM 17
BLDG NUM 15
F-1
D-1R
PARKING











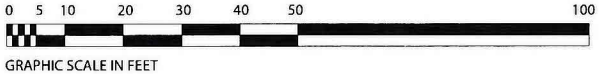
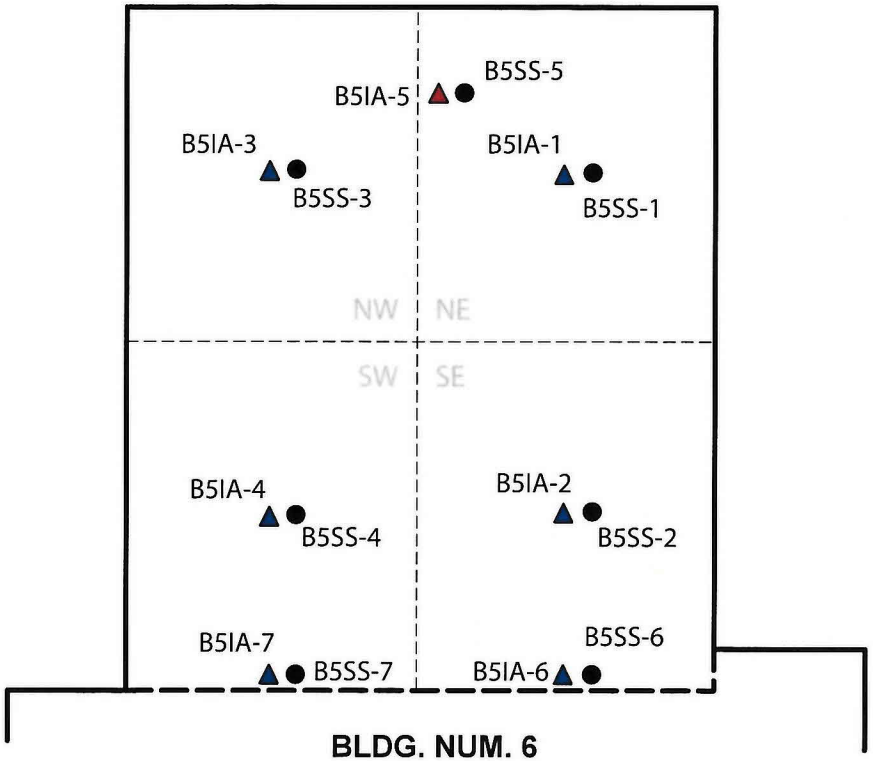


Figure 4

Building 5 Area
Vapor Intrusion Investigation Area

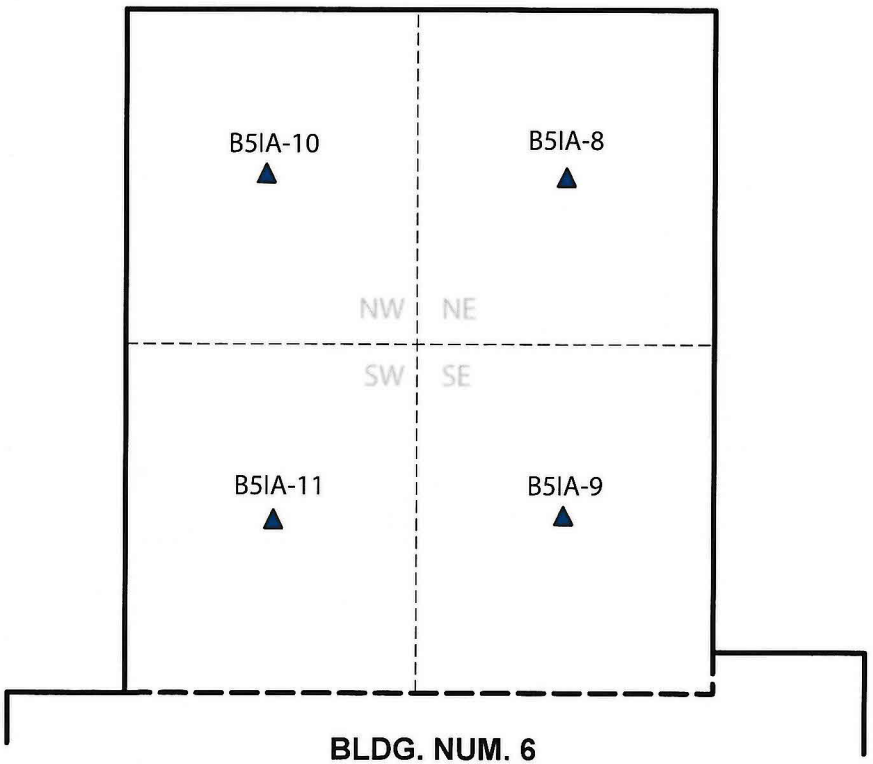
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico

BLDG. NUM. 5
1st FLOOR

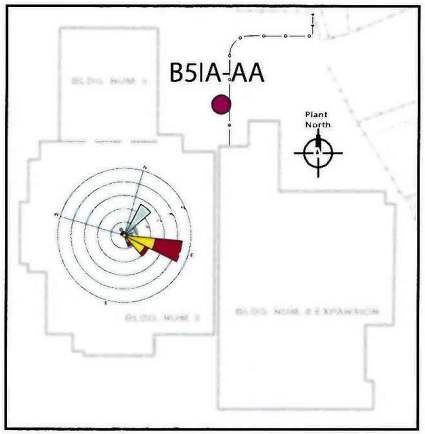


BLDG. NUM. 6

BLDG. NUM. 5
2nd FLOOR

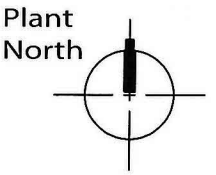


BLDG. NUM. 6



LEGEND

- ▲ INDOOR AIR BREATHING SPACE SAMPLE LOCATION
- ▲ INDOOR AIR FLOOR SAMPLE LOCATION
- ● SUB-SLAB SOIL GAS SAMPLE LOCATION
- ● AMBIENT AIR SAMPLE LOCATION

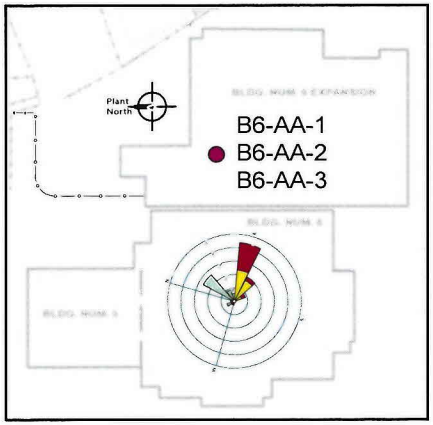


Not to Scale

Figure 5

Approximate Location of Building 5 Indoor Air and Sub-Slab Sample Locations (Collected Dec 2014)

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



B6-3SS
B6-3IA

SHIPPING OFFICE (ROOM 188A)

SHIPPING (ROOM 188)

SERVICE CORRIDOR (ROOM 189)

B6-4SS
B6-4IA

WATER PURIFICATION AREA (ROOM 129)

TANK ROOM

EQUIPMENT ROOM

B6-5SS
B6-5IA

BUILDING 6

BUILDING 5

WAREHOUSE (ROOM 128)

B6-2SS
B6-2IA

NE SE

NW SW

WAREHOUSE (ROOM127)

B6-1SS
B6-1IA

LEGEND

- INDOOR AIR BREATHING SPACE SAMPLE LOCATION
- SUB-SLAB SOIL GAS SAMPLE LOCATION
- AMBIENT AIR SAMPLE LOCATION

Plant North

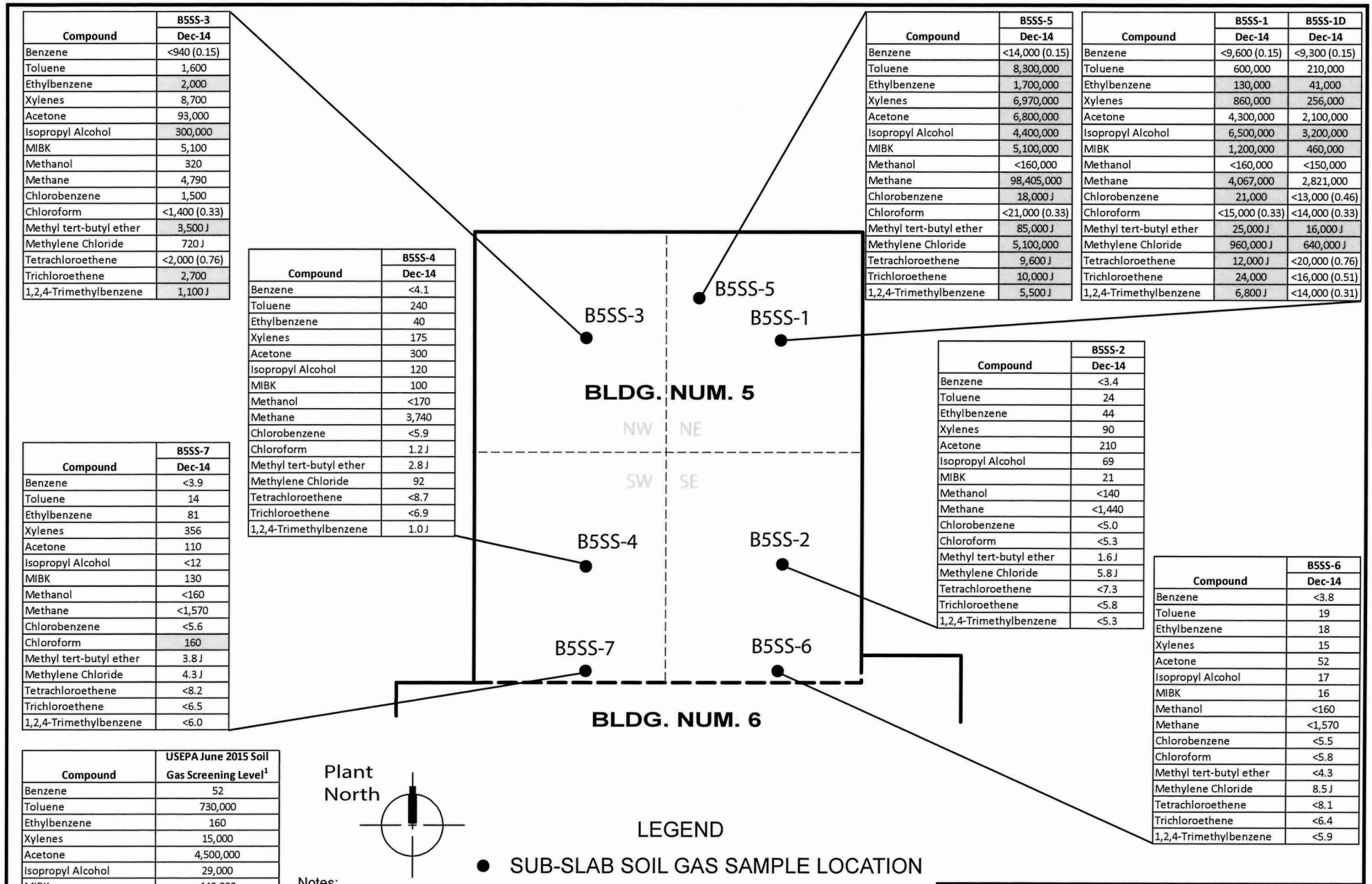
0 5 10 20 30 40 50 100

GRAPHIC SCALE IN FEET

Figure 6

Approximate Location of Building 6 Indoor Air and Sub-Slab Sample Locations (Collected Feb-Mar and Jun 2015)

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



Compound	B5SS-3 Dec-14
Benzene	<940 (0.15)
Toluene	1,600
Ethylbenzene	2,000
Xylenes	8,700
Acetone	93,000
Isopropyl Alcohol	300,000
MIBK	5,100
Methanol	320
Methane	4,790
Chlorobenzene	1,500
Chloroform	<1,400 (0.33)
Methyl tert-butyl ether	3,500 J
Methylene Chloride	720 J
Tetrachloroethene	<2,000 (0.76)
Trichloroethene	2,700
1,2,4-Trimethylbenzene	1,100 J

Compound	B5SS-4 Dec-14
Benzene	<4.1
Toluene	240
Ethylbenzene	40
Xylenes	175
Acetone	300
Isopropyl Alcohol	120
MIBK	100
Methanol	<170
Methane	3,740
Chlorobenzene	<5.9
Chloroform	1.2 J
Methyl tert-butyl ether	2.8 J
Methylene Chloride	92
Tetrachloroethene	<8.7
Trichloroethene	<6.9
1,2,4-Trimethylbenzene	1.0 J

Compound	B5SS-7 Dec-14
Benzene	<3.9
Toluene	14
Ethylbenzene	81
Xylenes	356
Acetone	110
Isopropyl Alcohol	<12
MIBK	130
Methanol	<160
Methane	<1,570
Chlorobenzene	<5.6
Chloroform	160
Methyl tert-butyl ether	3.8 J
Methylene Chloride	4.3 J
Tetrachloroethene	<8.2
Trichloroethene	<6.5
1,2,4-Trimethylbenzene	<6.0

Compound	B5SS-5 Dec-14
Benzene	<14,000 (0.15)
Toluene	8,300,000
Ethylbenzene	1,700,000
Xylenes	6,970,000
Acetone	6,800,000
Isopropyl Alcohol	4,400,000
MIBK	5,100,000
Methanol	<160,000
Methane	98,405,000
Chlorobenzene	18,000 J
Chloroform	<21,000 (0.33)
Methyl tert-butyl ether	85,000 J
Methylene Chloride	5,100,000
Tetrachloroethene	9,600 J
Trichloroethene	10,000 J
1,2,4-Trimethylbenzene	5,500 J

Compound	B5SS-1 Dec-14	B5SS-1D Dec-14
Benzene	<9,600 (0.15)	<9,300 (0.15)
Toluene	600,000	210,000
Ethylbenzene	130,000	41,000
Xylenes	860,000	256,000
Acetone	4,300,000	2,100,000
Isopropyl Alcohol	6,500,000	3,200,000
MIBK	1,200,000	460,000
Methanol	<160,000	<150,000
Methane	4,067,000	2,821,000
Chlorobenzene	21,000	<13,000 (0.46)
Chloroform	<15,000 (0.33)	<14,000 (0.33)
Methyl tert-butyl ether	25,000 J	16,000 J
Methylene Chloride	960,000 J	640,000 J
Tetrachloroethene	12,000 J	<20,000 (0.76)
Trichloroethene	24,000	<16,000 (0.51)
1,2,4-Trimethylbenzene	6,800 J	<14,000 (0.31)

Compound	B5SS-2 Dec-14
Benzene	<3.4
Toluene	24
Ethylbenzene	44
Xylenes	90
Acetone	210
Isopropyl Alcohol	69
MIBK	21
Methanol	<140
Methane	<1,440
Chlorobenzene	<5.0
Chloroform	<5.3
Methyl tert-butyl ether	1.6 J
Methylene Chloride	5.8 J
Tetrachloroethene	<7.3
Trichloroethene	<5.8
1,2,4-Trimethylbenzene	<5.3

Compound	B5SS-6 Dec-14
Benzene	<3.8
Toluene	19
Ethylbenzene	18
Xylenes	15
Acetone	52
Isopropyl Alcohol	17
MIBK	16
Methanol	<160
Methane	<1,570
Chlorobenzene	<5.5
Chloroform	<5.8
Methyl tert-butyl ether	<4.3
Methylene Chloride	8.5 J
Tetrachloroethene	<8.1
Trichloroethene	<6.4
1,2,4-Trimethylbenzene	<5.9

Compound	USEPA June 2015 Soil Gas Screening Level[1]
Benzene	52
Toluene	730,000
Ethylbenzene	160
Xylenes	15,000
Acetone	4,500,000
Isopropyl Alcohol	29,000
MIBK	440,000
Methanol	2,900,000
Methane[2]	3,280,000
Chlorobenzene	7300
Chloroform	18
Methyl tert-butyl ether	1,600
Methylene Chloride	41,000
Tetrachloroethene	1,600
Trichloroethene	100
1,2,4-Trimethylbenzene	1,000

LEGEND

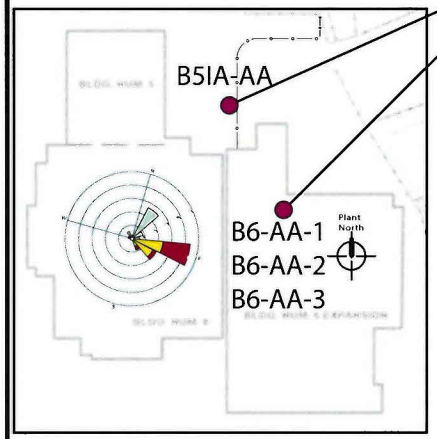
● SUB-SLAB SOIL GAS SAMPLE LOCATION

Notes:
Not to scale
All concentrations are in $\mu g/m^3$
Shaded values exceed the applicable USEPA June 2015 soil gas screening level
Non-detect results are reported as "<" the reporting limit.
The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.
See Table 2 for definition of laboratory and validation qualifiers.
[1] USEPA Vapor Intrusion Screening Level Calculator Version 3.4, June 2015 RSLs.
[2] Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015).

Figure 7

Distribution of Building 5
Sub-Slab Soil Gas Analytical Results

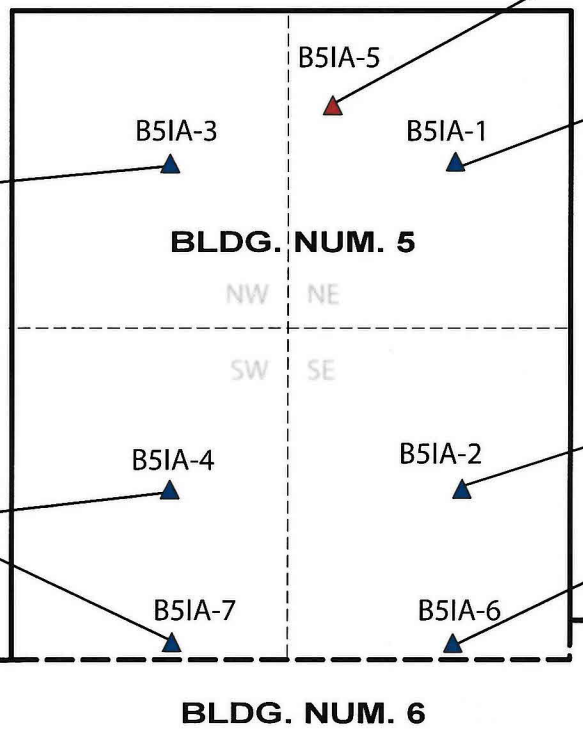
Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



Compound	B5IA-AA Dec-14	B6-AA-1 Feb-15	B6-AA-2 Mar-15	B6-AA-3 Jun-15
Benzene	<0.53	2.9	0.63	<0.54
Toluene	3.0	21	0.64	0.44 J
Ethylbenzene	0.86	12	0.13 J	0.17 J
Xylenes	2.0	11.6	0.12 J	1.12 J
Acetone	12	790 E	4.4 J	12
Isopropyl Alcohol	5.6	190 E	0.90 J	0.98 J
MIBK	1.2	2.3	0.096 J	2.7
Methanol	<110	<100	<90	<110
Methane	1,310	1,250	980	1,250
Chloroform	<0.82 (0.12)	0.30 J	<0.67 (0.12)	<0.82 (0.12)

Compound	B5IA-5 Dec-14
Benzene	<2.5 (0.080)
Toluene	1,300 E
Ethylbenzene	200
Xylenes	773
Acetone	1,400 E
Isopropyl Alcohol	1,000 E
MIBK	660
Methanol	<100
Methane	12,460
Chloroform	1.3 J

Compound	B5IA-1 Dec-14
Benzene	<1.1
Toluene	730 E
Ethylbenzene	110
Xylenes	460
Acetone	820 E
Isopropyl Alcohol	510 E
MIBK	440
Methanol	<110
Methane	9,180
Chloroform	1.8



Compound	B5IA-3 Dec-14	B5IA-3D Dec-14
Benzene	<0.95	<0.92
Toluene	710 E	570 E
Ethylbenzene	120	95
Xylenes	460	371
Acetone	750 E	650 E
Isopropyl Alcohol	500 E	410 E
MIBK	410	320
Methanol	<98	<190
Methane	9,180	7,870
Chloroform	1.0 J	1.2 J

Compound	B5IA-2 Dec-14
Benzene	1.3
Toluene	450 E
Ethylbenzene	71
Xylenes	285
Acetone	510 E
Isopropyl Alcohol	380 E
MIBK	250
Methanol	<110
Methane	6,560
Chloroform	1.9

Compound	B5IA-4 Dec-14
Benzene	0.57
Toluene	520 E
Ethylbenzene	85
Xylenes	328
Acetone	570 E
Isopropyl Alcohol	400 E
MIBK	290 E
Methanol	<110
Methane	7,870
Chloroform	1.6

Compound	B5IA-7 Dec-14
Benzene	0.74
Toluene	520 E
Ethylbenzene	81
Xylenes	317
Acetone	580 E
Isopropyl Alcohol	400 E
MIBK	290
Methanol	<120
Methane	7,870
Chloroform	1.6

Compound	B5IA-6 Dec-14
Benzene	0.70
Toluene	370 E
Ethylbenzene	56
Xylenes	218
Acetone	510 E
Isopropyl Alcohol	380 E
MIBK	210
Methanol	<100
Methane	5,900
Chloroform	1.8

LEGEND

▲ INDOOR AIR BREATHING SPACE SAMPLE LOCATION

▲ INDOOR AIR FLOOR SAMPLE LOCATION

● AMBIENT AIR SAMPLE LOCATION

Plant North

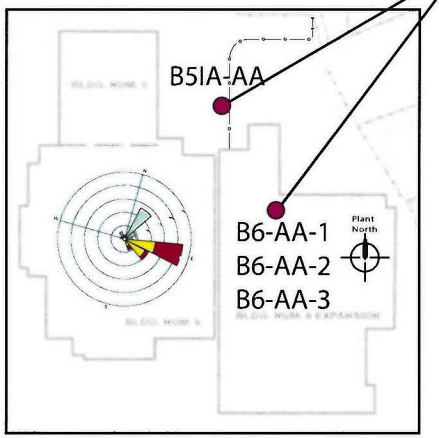
Compound	USEPA Industrial Indoor Air Screening Level[1]
Benzene	1.6
Toluene	22,000
Ethylbenzene	4.9
Xylenes	440
Acetone	140,000
Isopropyl Alcohol	880
MIBK	13,000
Methanol	88,000
Methane[2]	3,280,000
Chloroform	0.53

Notes:
Not to scale
All concentrations are in $\mu g/m^3$
Shaded values exceed the applicable USEPA June 2015 indoor air screening level
Non-detect results are reported as "<" the reporting limit.
The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.
See Table 3 for definition of laboratory and validation qualifiers.
[1] USEPA Regional Screening Levels, June 2015.
[2] Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015).

Figure 8

Distribution of Building 5 First Floor Analytical Results

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



Compound	B5IA-AA Dec-14	B6-AA-1 Feb-15	B6-AA-2 Mar-15	B6-AA-3 Jun-15
Benzene	<0.53	2.9	0.63	<0.54
Toluene	3.0	21	0.64	0.44 J
Ethylbenzene	0.86	12	0.13 J	0.17 J
Xylenes	2.0	11.6	0.12 J	1.12 J
Acetone	12	790 E	4.4 J	12
Isopropyl Alcohol	5.6	190 E	0.90 J	0.98 J
MIBK	1.2	2.3	0.096 J	2.7
Methanol	<110	<100	<90	<110
Methane	1,310	1,250	980	1,250
alpha-Chlorotoluene	<4.3 UJ (0.33)	<4.0 (0.33)	<0.71 (0.33)	0.29 J

B5IA-10

B5IA-8

BLDG. NUM. 5

NW NE

SW SE

B5IA-11

B5IA-9

BLDG. NUM. 6

Compound	B5IA-10 Dec-14
Benzene	<0.58
Toluene	64
Ethylbenzene	9.5
Xylenes	38
Acetone	86
Isopropyl Alcohol	61
MIBK	34
Methanol	<120
Methane	2,100
alpha-Chlorotoluene	0.56 J

Compound	B5IA-8 Dec-14
Benzene	<0.55
Toluene	80
Ethylbenzene	12
Xylenes	48.5
Acetone	100
Isopropyl Alcohol	73
MIBK	43
Methanol	<110
Methane	2,160
alpha-Chlorotoluene	<4.5 UJ (0.33)

Compound	B5IA-11 Dec-14
Benzene	<0.58
Toluene	71
Ethylbenzene	11
Xylenes	43.3
Acetone	92
Isopropyl Alcohol	70
MIBK	37
Methanol	<120
Methane	2,030
alpha-Chlorotoluene	<4.7 UJ (0.33)

Compound	B5IA-9 Dec-14
Benzene	<0.51
Toluene	72
Ethylbenzene	11
Xylenes	44
Acetone	100
Isopropyl Alcohol	70
MIBK	36
Methanol	<100
Methane	2,100
alpha-Chlorotoluene	<4.2 UJ (0.33)

LEGEND

▲ INDOOR AIR BREATHING SPACE SAMPLE LOCATION

● AMBIENT AIR SAMPLE LOCATION

Plant North

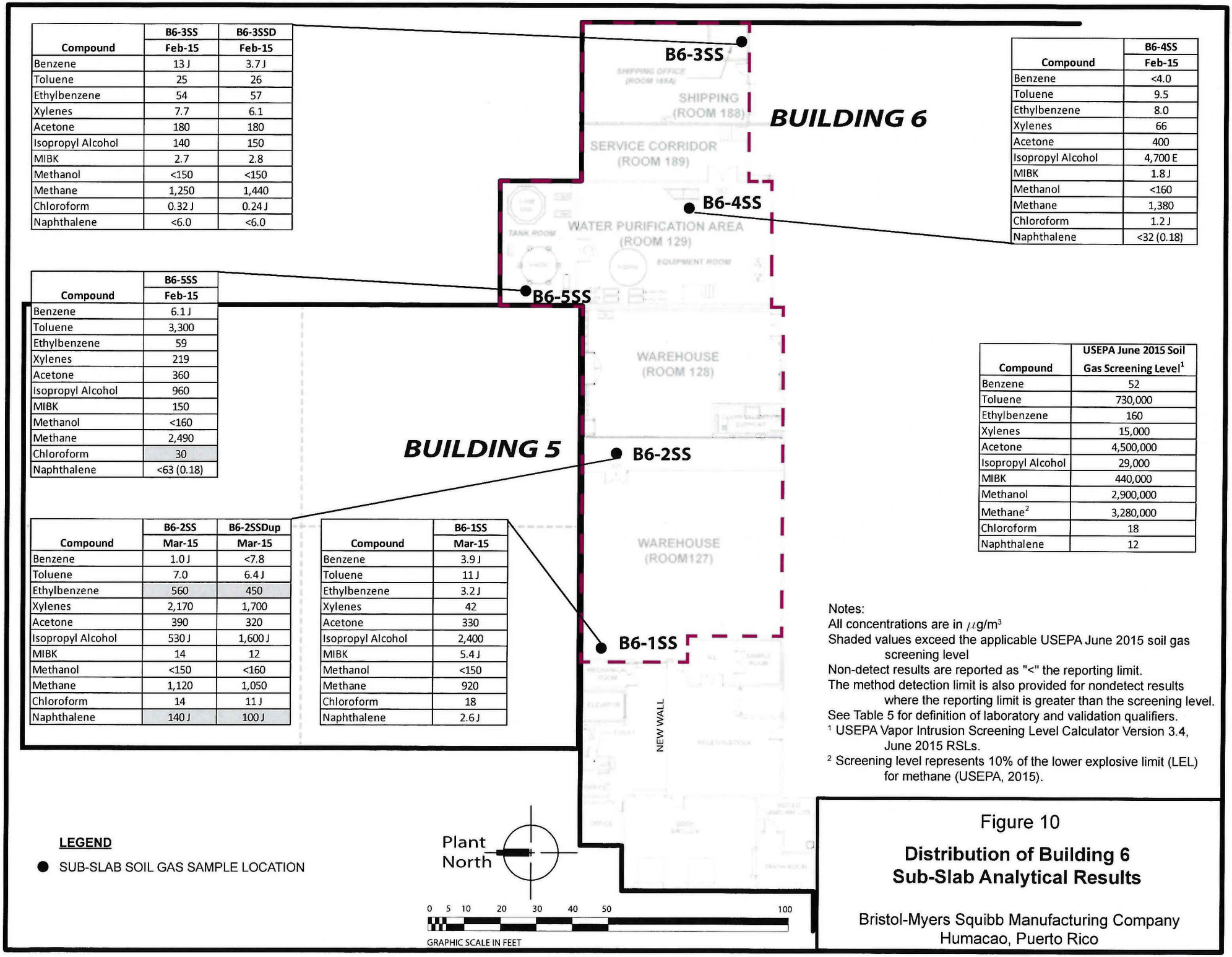
Compound	USEPA Industrial Indoor Air Screening Level[1]
Benzene	1.6
Toluene	22,000
Ethylbenzene	4.9
Xylenes	440
Acetone	140,000
Isopropyl Alcohol	880
MIBK	13,000
Methanol	88,000
Methane[2]	3,280,000
alpha-Chlorotoluene	0.25

Notes:
Not to scale
All concentrations are in $\mu g/m^3$
Shaded values exceed the applicable USEPA June 2015 indoor air screening level
Non-detect results are reported as "<" the reporting limit.
The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.
See Table 4 for definition of laboratory and validation qualifiers.
[1] USEPA Regional Screening Levels, June 2015.
[2] Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015).

Figure 9

Distribution of Building 5
Second Floor Analytical Results

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



Compound	B6-3SS Feb-15	B6-3SSD Feb-15
Benzene	13 J	3.7 J
Toluene	25	26
Ethylbenzene	54	57
Xylenes	7.7	6.1
Acetone	180	180
Isopropyl Alcohol	140	150
MIBK	2.7	2.8
Methanol	<150	<150
Methane	1,250	1,440
Chloroform	0.32 J	0.24 J
Naphthalene	<6.0	<6.0

Compound	B6-4SS Feb-15
Benzene	<4.0
Toluene	9.5
Ethylbenzene	8.0
Xylenes	66
Acetone	400
Isopropyl Alcohol	4,700 E
MIBK	1.8 J
Methanol	<160
Methane	1,380
Chloroform	1.2 J
Naphthalene	<32 (0.18)

Compound	B6-5SS Feb-15
Benzene	6.1 J
Toluene	3,300
Ethylbenzene	59
Xylenes	219
Acetone	360
Isopropyl Alcohol	960
MIBK	150
Methanol	<160
Methane	2,490
Chloroform	30
Naphthalene	<63 (0.18)

Compound	USEPA June 2015 Soil Gas Screening Level[1]
Benzene	52
Toluene	730,000
Ethylbenzene	160
Xylenes	15,000
Acetone	4,500,000
Isopropyl Alcohol	29,000
MIBK	440,000
Methanol	2,900,000
Methane[2]	3,280,000
Chloroform	18
Naphthalene	12

Compound	B6-2SS Mar-15	B6-2SSDup Mar-15
Benzene	1.0 J	<7.8
Toluene	7.0	6.4 J
Ethylbenzene	560	450
Xylenes	2,170	1,700
Acetone	390	320
Isopropyl Alcohol	530 J	1,600 J
MIBK	14	12
Methanol	<150	<160
Methane	1,120	1,050
Chloroform	14	11 J
Naphthalene	140 J	100 J

Compound	B6-1SS Mar-15
Benzene	3.9 J
Toluene	11 J
Ethylbenzene	3.2 J
Xylenes	42
Acetone	330
Isopropyl Alcohol	2,400
MIBK	5.4 J
Methanol	<150
Methane	920
Chloroform	18
Naphthalene	2.6 J

Notes:
All concentrations are in $\mu g/m^3$
Shaded values exceed the applicable USEPA June 2015 soil gas screening level
Non-detect results are reported as "<" the reporting limit.
The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.
See Table 5 for definition of laboratory and validation qualifiers.
[1] USEPA Vapor Intrusion Screening Level Calculator Version 3.4, June 2015 RSLs.
[2] Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015).

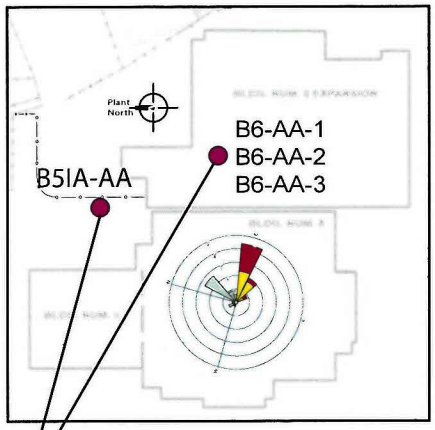
LEGEND

● SUB-SLAB SOIL GAS SAMPLE LOCATION

Figure 10

Distribution of Building 6 Sub-Slab Analytical Results

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico



Compound	B6-4IA Feb-15
Benzene	0.28 J
Toluene	6.3
Ethylbenzene	0.74
Xylenes	2.92
Acetone	22
Isopropyl Alcohol	89
MIBK	1.5
Methanol	<110
Methane	1,440
Chloroform	1.6

Compound	B6-3IA Feb-15	B6-3IAD Feb-15
Benzene	0.33 J	0.32 J
Toluene	8.7	6.7
Ethylbenzene	0.20 J	0.20 J
Xylenes	0.90 J	0.82 J
Acetone	19	16
Isopropyl Alcohol	120	120
MIBK	<0.64	<0.72
Methanol	<100	<120
Methane	1,250	1,310
Chloroform	<0.77 (0.12)	<0.86 (0.12)

Compound	B6-5IA Feb-15
Benzene	0.37 J
Toluene	8.2
Ethylbenzene	1.1
Xylenes	4.54
Acetone	16
Isopropyl Alcohol	39
MIBK	3.0
Methanol	<110
Methane	1,440
Chloroform	1.0

Compound	B5IA-AA Dec-14	B6-AA-1 Feb-15	B6-AA-2 Mar-15	B6-AA-3 Jun-15
Benzene	<0.53	2.9	0.63	<0.54
Toluene	3.0	21	0.64	0.44 J
Ethylbenzene	0.86	12	0.13 J	0.17 J
Xylenes	2.0	11.6	0.12 J	1.12 J
Acetone	12	790 E	4.4 J	12
Isopropyl Alcohol	5.6	190 E	0.90 J	0.98 J
MIBK	1.2	2.3	0.096 J	2.7
Methanol	<110	<100	<90	<110
Methane	1,310	1,250	980	1,250
Chloroform	<0.82 (0.12)	0.30 J	<0.67 (0.12)	<0.82 (0.12)

Compound	B6-2IA Mar-15	B6-2IADup Mar-15	B6-2IA-2 Jun-15	B6-2IAD-2 Jun-15
Benzene	0.84 J	0.36 J	<0.53	<0.49
Toluene	2.6	2.2	0.87	0.93
Ethylbenzene	0.60 J	0.58 J	<0.72	<0.66
Xylenes	1.9	1.73	0.16 J	0.16 J
Acetone	31 J	17 J	13	7.7
Isopropyl Alcohol	2,000	2,100	31	32
MIBK	0.82 J	0.68 J	<0.68	<0.63
Methanol	<100	<110	<110	<100
Methane	1,180	1,640	1,310	1,250
Chloroform	<1.3 (0.12)	<1.3 (0.12)	<0.81 (0.12)	<0.75 (0.12)

Compound	B6-1IA Mar-15	B6-1IA-2 Jun-15
Benzene	0.32 J	<0.51
Toluene	1.7	0.67
Ethylbenzene	0.46 J	<0.69
Xylenes	1 J	0.19 J
Acetone	18 J	4.9
Isopropyl Alcohol	3,900	9.7
MIBK	0.40 J	<0.65
Methanol	<100	<100
Methane	1,120	1,250
Chloroform	<1.9 (0.12)	<0.78 (0.12)

Compound	USEPA Industrial Indoor Air Screening Level[1]
Benzene	1.6
Toluene	22,000
Ethylbenzene	4.9
Xylenes	440
Acetone	140,000
Isopropyl Alcohol	880
MIBK	13,000
Methanol	88,000
Methane[2]	3,280,000
Chloroform	0.53

Notes:
All concentrations are in $\mu g/m^3$
Shaded values exceed the applicable USEPA June 2015 indoor air screening level
Non-detect results are reported as "<" the reporting limit.
The method detection limit is also provided for nondetect results where the reporting limit is greater than the screening level.
See Table 6 for definition of laboratory and validation qualifiers.
[1] USEPA Regional Screening Levels, June 2015.
[2] Screening level represents 10% of the lower explosive limit (LEL) for methane (USEPA, 2015).

LEGEND

▲ FIRST FLOOR BREATHING ZONE INDOOR AIR SAMPLE LOCATION

● AMBIENT AIR SAMPLE LOCATION

Figure 11

Distribution of Building 6 Indoor Air Analytical Results

Bristol-Myers Squibb Manufacturing Company
Humacao, Puerto Rico